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ABSTRACT

The purpose of this document is to provide students and counselors with a guide to the academic institutions offering courses in the marine sciences. One hundred thirty-eight institutions offering at least 25 semester hours in the marine field are listed both alphabetically and geographically by States. The information relating to each institution is organized as follows: a description of the facilities available, including research laboratories and vessels; the degree programs in the marine field, usually with the entrance and course requirements specified; a list of the marine courses offered and the credit given, according to each school's system; a list of the faculty members involved with the degree programs; and the name of the person to contact for further information. (JR)

UNIVERSITY CURRICULA IN THE MARINE SCIENCES AND RELATED FIELDS

ACADEMIC YEARS 1973-1974, 1974-1975

Interagency Committee on Marine Science and Engineering
Federal Council for Science and Technology

UNIVERSITY CURRICULA IN THE MARINE SCIENCES AND RELATED FIELDS

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Interagency Committee on Marine [illegible]
Federal Council for [illegible]

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FOREWORD

To the youth of today is offered a field of endeavor of almost unlimited scope. The planet's millions of square miles of ocean waters provide a living laboratory for the marine scientist or technician. His tools are a mix of earth satellites, instrumented aircraft, research ships, automated sensor stations, giant computers..... and the human mind. Seeking new and practical knowledge of the global oceans, their living and mineral resources, their effects on and interactions with the earth's dry land and atmospheric envelope..... this is the task and reward of those in the marine sciences. It is a singular opportunity to contribute to our nation and to humanity.

This report, University Curricula in the Marine Sciences and Related Fields, will provide invaluable assistance to students planning a career in the marine sciences or any one who needs up-to-date information on what academia has to offer in this important field.

We are grateful for the cooperation of the many administrators and faculty members of the institutions who supplied the information for this report.

Robert M. White

Robert M. White
Chairman
Interagency Committee on Marine
Science & Engineering

INTRODUCTION

General. This edition of "University Curricula in the Marine Sciences and Related Fields," the seventh in a series inaugurated by the old Interagency Committee on Oceanography, is designed to answer the question often asked by students and guidance counselors about which colleges and universities teach marine courses.

Its purpose is to provide a guide rather than a definitive description of current offerings in the marine field. Students, counselors and others using the volume should select from it institutions of interest to contact directly for full information concerning admission requirements, scholarship-fellowship availability, the specific courses which are being offered during particular semesters and related matters.

The information in this publication was provided by officials at each college or university. As the material was gathered during the early part of 1973, references in some of the program descriptions to "this year" likely mean the 1972-73 academic year.

The criterion for including an institution in this edition was that it offer a program of at least 25 semester hours in the marine field, broadly defined. Although this definition represents an increase from the previous edition, where the criterion of 15 credit hours was used, the number of responding institutions increased. Also, several institutions which qualify were not able to prepare their material in time for inclusion. In all, over 300 questionnaires were distributed.

Inquiries to the institutions asked about programs in all areas of marine studies, from two-year technology training courses to Ph. D. offerings. Programs in marine law, fisheries and food science, the maritime field and naval architecture were specifically included, as well as any new, interdisciplinary programs that might fall outside traditional organizational structures.

Reports from the institutions are listed alphabetically and are organized as follows:

- a description of the facilities available, including research labs and vessels
- the degree programs in the marine field, usually with the entrance and course requirements specified
- a list of the marine courses offered and the credit given, according to each school's system
- a list of the faculty members involved with the degree programs, alphabetically and in most cases with the highest degree earned
- the name of the contact person for further information

The geographic index will help identify facilities in a given region.

Scholarship Information. There is a variety of excellent guides to scholarship and fellowship information available. Without exception they point to the institutions themselves as the principal source of information, but nonetheless provide useful descriptions of the different types of aid programs available.

One of the best is published annually by the American Legion. "Need a Lift?" is published each fall for 50 cents (Dept. S, P. O. Box 1055, Indianapolis, Indiana 46206) and, while naturally heavy in emphasis on aid to children of veterans, is a comprehensive listing of government, business and organization-provided aid. The 140-page booklet (1972 edition) describes the $4 billion that is available to qualified students. Included in the American Legion publication is a list of books carried in most libraries which provide guides to colleges and to scholarship assistance. The booklet also provides a state-by-state list of educational benefits and the eligibility requirements for each.

Students and counselors would also be well advised to contact a U. S. Representative or Senator from their home state for copies of available federal government documents describing current aid programs. Such programs often undergo change and it will be important to obtain the most recent information available. The U. S. Office of Education currently makes available a one-page fact sheet outlining its aid programs.

High school guidance offices will have information available about sources of financial aid and can provide leads to publications available in the community which provide further information.

Career Guidance. Students looking into the marine field as a possible future career would do well to talk to as many people familiar with the field as possible. Oceanography has attracted considerable worldwide attention and has also been the object of some exaggerated estimates of future growth as a field of endeavor.

A realistic guide to the field from the career standpoint is the booklet, "The Oceans and You," published by the Marine Technology Society ($3. 00 prepaid, 1730 M Street, N. W., Suite 412, Washington, D. C. 20036). Included are two introductory discussions of the field, job descriptions

from sample employers among private industry, government agencies and universities; a capsule list of institutions offering marine programs; a comprehensive reading list; a description of marine technician training programs; a list of sources of additional information about the field, and some suggestions about personal actions for an interested individual.

Other career guidance publications available include the following: "So You Want to Be a Marine Scientist," Miami Seaquarium, Rickenbacker Causeway, Miami, Florida; "Geophysics, The Earth in Space," American Geophysical Union, 1707 L Street, N.W., Washington, D.C. 20036; "Your Career in Oceanology," by Waldo Boyd, Julian Messner, New York, 1968, $3.95; "Your Future in Oceanography," by Norman H. Gaber, Richards Rosen Press, New York, New York, 1967, $4.00; "Opportunities in Oceanography," Smithsonian Press, Smithsonian Institution, Washington, D.C. 20560, $1.25, and "Training and Careers in Marine Science," International Oceanographic Foundation, Virginia Key, Miami, Florida.

Good sources of general information are the federal government agencies with marine programs. Among them are:

Department of Commerce, National Oceanic and Atmospheric Administration and Maritime Administration.

Department of the Interior, Geological Survey and Bureau of Sport Fish and Wildlife.

Department of the Navy, Office of Naval Research, Naval Oceanographic Office and Oceanographer of the Navy.

Department of Transportation, U.S. Coast Guard.

Additional information may be obtained from such diverse sources as the Department of State, Smithsonian Institution and Environmental Protection Agency.

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GEOGRAPHIC LISTING

ADELPHI UNIVERSITY
Garden City, Long Island, New York 11530

Adelphi University Institute of Marine Science has research and teaching facilities at Oakdale, Long Island, New York, and at the main campus in Garden City.

The principle research facility is the Institute of Marine Science, located on the Connetquot River, approximately one mile from Great South Bay. The physical facilities include seven laboratories, two walk-in cold rooms, a shop, and instrument and storage rooms. The R/V Blue Chip, a 40-foot twin-engine cabin cruiser, and the R/V Janet D, a 37-foot lobster boat equipped with radio-telephone, fathometer, and generators, are utilized for estuarine research on the Great South Bay System. Opportunities for oceanographic cruise experience and research are available and encouraged. Research equipment include induction salinometers, submarine photometer, otter trawl, seine nets, oxygen analyzers, specific-ion probes, pH meters, spectrophotometers, microscopes, photographic equipment, Scuba gear, climate control chambers, centrifuges, and a seismic hammer with six channels.

The following degrees are offered:

1. B.A. Interdisciplinary Major in Marine and Environmental Science, sponsored by Biology and Earth Science Departments and Institute of Marine Science.
   a) Biology 20 credits
   b) Earth Science 20 credits
   c) Chemistry 12 credits
   d) Physics 8 credits
   e) Mathematics 8 credits
2. M.S. in Biology. Non-thesis degree with specialization in marine biology, 36 credits.
3. M.S. in Biology. Thesis degree with specialization in marine biology.
   a) Thirty-three credits including eight for thesis research.
   b) Two biology laboratory courses.
   c) Presentation of a master's thesis.
   d) A reading knowledge of french, german or russian.
   e) A comprehensive examination, oral or written.
4. M.S. in Earth Science, specializing in marine science and environmental science.
   a) Successful completion of 33 graduate credits as follows:
      Earth Science 21-24 credits
      Mathematics 3-6 credits
      Electives 3-6 credits

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

Bio 13	Invertebrate Zoology	4
Bio 23	Marine Biology	4
Bio 24	Ecology	4
Bio 111	Special Problems in Biology	arr.
Bio 112	Special Problems in Biology	arr.
Bio 175	Marine Biology Field Trip	2
ES 4	Environmental Geology	3
ES 24	Marine Science	4

GRADUATE COURSES

Bio 201	Marine Biology	4
Bio 204	Ecological Systems	4
Bio 211	Selected Topics - Marine Invertebrates	3
	Selected Topics - Biological Oceanography	3
	Selected Topics - Productivity	3
	Selected Topics - Ichthyology	3
Bio 213	Marine Seminar - Contemporary Problems in Sources, Nature and Control of Pollutants	2
Bio 237	Marine Botany	4
Bio 238	Marine Ecology	4
Bio 239	Marine Microbiology	4
Bio 287	Special Research Problems	1
Bio 288	Special Research Problems	1
Bio 293	Thesis Research	3
Bio 294	Thesis Research	3
ES 227	Geochemistry	4
ES 230-239	Special Topics in Earth Science	
	Environmental Monitoring (235)	3
	Environmental Awareness (234)	3
	Environmental Conservation (237)	3
	Environmental and Engineering Geology (239)	3
ES 254	Principles of Oceanography	3
ES 261	Marine Geology	3
ES 265	Coastal Processes	3
ES 271	Climatology	3
ES 274	Principles of Hydrology	3
ES 298	Guided Research	3
ES 299	Master's Thesis Research	3
ES 290	Earth Science Seminar	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Brenowitz, A. Harry, Ed.D., Professor
Cassin, Joseph M., Ph.D., Assistant Professor
Churchill, A. Coolidge, Ph.D., Assistant Professor

EARTH SCIENCE

Cok, Anthony, Ph.D., Assistant Professor
McNeal, James, M.S., Instructor
Sirkin, Leslie, Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. A. Harry Brenowitz, Director
Institute of Marine Science
Adelphi University
Garden City, Long Island, New York 11530

UNIVERSITY OF ALABAMA
Dauphin Island Sea Lab
Dauphin Island, Alabama 36528

The University of Alabama marine science program is supported jointly by the University of Alabama, Tuscaloosa and the University of Alabama in Birmingham. The marine science program is a part of the Marine Environmental Sciences Consortium, Inc. Laboratories and faculty offices are located at the Dauphin Island Sea Lab, Dauphin Island; the director's office is in Tuscaloosa.

At the Point Aux Pins marsh lab there is a research building with two large laboratories equipped for general utilization and a large quarters room for researchers and visiting groups.

The University of Alabama, Tuscaloosa and Birmingham offer B.S. degrees in biology with emphasis in marine science. The Birmingham campus offers an M.S. in Biology with emphasis in marine science and the Tuscaloosa campus offers a M.S. in Marine Science (biology).

In the past year there were approximately 40 students in the B.S. program. The M.S. in Marine Science (biology) is a new program.

The marine science program has an extensive scientific diver training program which utilizes the new swimming pool on Dauphin Island. Students must be nationally

certified to enter the program whereafter they receive scientific training and ocean qualification dives under supervision followed by a week in Freeport, Bahamas for familiarization with the Hydrolab underwater manned habitat and submersibles.

A year-round program of instruction is offered at Dauphin Island as a part of the MESC instructional program.

Full-time University of Alabama faculty members at Dauphin Island include:

Brett, C. Everett, Ph. D., Director, Marine Geologist
Crozier, George F., Ph. D., Chief Scientist, Marine Physiology
Rounsefell, George A., Ph. D., Senior Marine Scientist, Marine Fisheries
Schroeder, William H., Ph. D., Assistant Marine Scientist, Physical Oceanography
Vittor, Barry A., Ph. D., Assistant Marine Scientist, Invertebrate Ecologist

The Marine Environmental Sciences Consortium is located at the Dauphin Island Sea Lab director adjacent to Mobile Inlet. The consortium has a membership of 17 Alabama four-year colleges and universities including: Alabama State University, Montgomery; Auburn University, Auburn; Birmingham-Southern College, Birmingham; Florence State University, Florence; Huntingdon College, Montgomery; Jacksonville State University, Jacksonville; Livingston University, Livingston; Mobile College, Mobile; Samford University, Birmingham; Spring Hill College, Mobile; Troy State University, Troy; Tuskegee Institute, Tuskegee; The University of Alabama, University; The University of Alabama in Birmingham, University Station; The University of Alabama in Huntsville, Huntsville; University of Montevallo, Montevallo, and University of South Alabama, Mobile.

Total facilities available include the Dauphin Island Sea Lab, the Point Aux Pins Marsh Lab at Point Aux Pins, the marine vessel maintenance facility at Bayou La Batre, three marine research vessels and several skiffs.

The Dauphin Island Sea Lab, consists of 27 buildings on the east ent of Dauphin Island, Among these is a large instructional building containing well-equipped research labs, classrooms and library; a combination administration-recreation building, two 84-person dormitories, a two-story efficiency apartment building, a cafeteria, support buildings, an oceanographic equipment building, 13 three-bedroom houses and a diver training pool.

The University of Alabama owns the 250-acre marsh lab, the vessel maintenance facility and three diesel-powered research vessels including the 65-foot R/V Aquarius, the 36-foot tunnel sterned Pisces and the 23-foot Gemini. These facilities are made available as a part of the total MESC complex.

MESC is a public non-profit corporation chartered by the state legislature in 1971. It is not a degree-granting institution; one of its principal functions is to support its 17 degree-granting schools with necessary marine related course offerings to satisfy their degree programs. All 17 schools have at least a B. S. in Biology with emphasis in marine science. Those schools with graduate programs have marine science-related degrees through the Ph. D. in some cases.

During the past year 115 students attended summer classes at the Sea Lab, In 1973 MESC will begin a full year-round program anticipating up to 300 students the first year.

The following list of courses are presently offered at the Sea Lab. (None of the courses are numbered since individual schools have their own numbering system,)

Ocean Science
Experimental Marine Embryology
Marine Vertebrate Zoology
Marine Invertebrate Zoology
Marine Geology
Coastal Engineering
Marine Biology
Marine Botany
Fisheries Science
Marine Cology
Coastal Ornithology
Physiology of Marine Organisms
Introduction to Oceanography
Techniques of Scientific Diving
Research on Special Topics
Seminar

For further information address all inquiries to:

Dr. C. Everett Brett, Coordinator
and Director U. of Alabama Marine Science Program
Marine Environmental Sciences Consortium, Inc.
Box 6282
University, Alabama 35486

UNIVERSITY OF ALASKA
Fairbanks, Alaska 99701

Situated on the main University of Alaska campus, the Institute of Marine Science is currently housed within the Duckering Building, The institute library employs a full-time librarian and contains over 8,000 volumes, together with a large reprint file relating principally to oceanography and ocean engineering, The institute also maintains shop, glassblowing, drafting and photographic services,

The institute has specialized gas chromatographs for determining permanent gases and hydrocarbon pollutants in seawater, Work on trace inorganic materials in both fresh water and seawater is accomplished by use of two atomic absorption spectrophotometers and specialized anodic stripping modules. In addition to two mass spectrometers for stable isotope analysis, facilities are available for determinations of gases, pigments, nutrients, carbon, nitrogen, radioactive tracers and separation of materials by high pressure liquid chromatography, Continuous culture apparatus is also available. The marine geology laboratory is equipped with standard-size analysis apparatus, pet-rographic microscopes, differential thermal analysis apparatus, and a pressure-flow system for diagenetic experiments.

The Seward Station, located on the north shore of Resurrection Bay, consists of a 14,000 sq. ft, machine shop and six acres of dockside property with 150 feet of dock. Laboratory space suitable for research in biology, chemistry and geo-chemistry is available, The Seward Station functions principally as an oceanographic outlet in support of the Research Vessel Acona,

In cooperation with the U. S, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, the Institute of Marine Science has constructed a field station on the shore of Izembek Lagoon, an embayment of the Bering Sea 15 miles from the village of Cold Bay.

For work in the Arctic Ocean and on the northern coast of Alaska, facilities are made available to the institute by the Naval Arctic Research Laboratory (NARL) at Point Barrow. NARL provides all logistic support, including rig transportation, for work on the north coast and on the T-3 Ice Island. The institute shares two hydro-huts with the physical oceanography group from the University of Washington.

The institute operates the R/V Acona as its principal oceanographic platform. The R/V Acona is an 85-foot steel vessel which carries a professional crew of six and a scientific party of nine. The Acona is equipped with an oceanographic winch, a light hydrographic winch, two radars, three depth sounders, a precision depth recorder, three radio transceivers, satellite navigation, loran, and other standard navigational equipment. The Acona has a

speed of nine knots and an endurance of three weeks of 4,500 miles.

The purpose of the program in oceanography is to train oceanographers at the M.S. and Ph.D. level. The program is coordinated by an interdisciplinary committee of the University composed of selected staff members from the academic colleges and research institutes involved with ocean science.

The following degrees are offered:

1. M.S. Degree in Biological Oceanography. (Thesis required) Prerequisites--B.S. in the natural sciences, courses in calculus and physical chemistry. Minimum credit requirements--30 graduate credits (nine of which may be thesis credits). Course requirements--OCN 620, OCN 650, OCN 661, and OCN 613, and a minimum of nine credits of additional course work to be selected by the student's committee.

2. M.S. Degree in Chemical Oceanography. (Thesis required) Prerequisites--B.S. in the natural sciences, courses in calculus and physical chemistry. Minimum credit requirements--30 graduate credits (nine of which may be thesis). Course requirements--OCN 620, OCN 6761, OCN 663, OCN 650, and OCN 613 or OCN 650 and a minimum of nine credits of additional course work to be selected by the student's committee.

3. M.S. Degree in Geological Oceanography. (Thesis required) Prerequisites--B.S. in the natural sciences, courses in calculus and physical chemistry. Minimum credit requirements--30 graduate credits (nine of which may be thesis credits). Course requirements--OCN 620, OCN 661, OCN 613, and OCN 650 or BIO 652, and a minimum of nine credits of additional course work to be selected by the student's committee.

4. M.S. Degree in Physical Oceanography. (Thesis required) Prerequisites--B.S. in the natural sciences, courses in calculus and physical chemistry. Minimum credit requirements--30 graduate credits (nine of which may be thesis credits). Course requirements--OCN 613, OCN 620, OCN 661, and OCN 650, and a minimum of nine credits of additional course work to be selected by the student's committee.

5. Ph.D. Degree. There are no fixed course requirements nor is an M.S. degree required to obtain the Ph.D. degree. The degree is awarded for proven ability and scholarly attainment, the exact program to be determined by the student's advisory committee. A candidate for the Ph.D. degree in Marine Science will be expected to have had course work at least equivalent to that of the M.S. curriculum.

The following courses are offered in conjunction with the above degrees:

OCN 613	Marine Geology	3
OCN 620	Introduction to Physical Oceanography	3
OCN 622	Ocean Currents and Water Masses	3
OCN 630	Estuarine Dynamics	3
OCN 650	Introduction to Biological Oceanography	3
OCN 661	Chemical Oceanography I	3
OCN 663	Chemical Oceanography II	3
OCN 690	Colloquium	3
OCN 691	Seminar	3
OCN 692	Seminar	3
OCN 693	Special Topics	arr.
OCN 694	Special Topics	arr.
OCN 697	Thesis	arr.
OCN 698	Thesis	arr.

BIOLOGY

Bio 652	Marine Ecology	3

CHEMISTRY

Chem 665	Cellular Biochemistry	3

GEOLOGY

Geo 401	Invertebrate Paleontology	4
Geo 631	Marine Geochemistry	3

PHYSICS

Phys 361	General Geophysics	3
Phys 362	General Geophysics	3
Phys 460	Geophysical Prospecting	3
Phys 465	Meteorology	3
Phys 621	Classical	3
Phys 625	Hydrodynamics	3
Phys 665	Dynamic Meteorology	3

WILDLIFE MANAGEMENT

W.M. 325	Scientific Sampling	3
W.M. 423	Limnology	3
W.M. 424	Ecology of Fishes	3
W.M. 426	The Analysis of Linearized Models	3
W.M. 624	Problems in Fisheries Management	2

The instructional staff for the courses listed above consists of the following:

Alexander, Vera A., Ph.D., Associate Professor of Marine Science; Limnology
Behlke, Charles E., Ph.D., Dean of College of Mathematics, Physical Sciences and Engineering; Professor of Engineering
Benson, Carl S., Ph.D., Professor of Geology and Geophysics
Burrell, David C., Ph.D., Associate Professor of Marine Science; Geochemistry
Button, Don K., Ph.D., Associate Professor of Marine Science; Biochemistry
Elsner, Robert, Ph.D., Professor of Marine Science; Marine Physiological Ecology
Forbes, Robert E., Ph.D., Professor of Geology; Igneous Petrology
Goering, John J., Ph.D., Professor of Marine Science; Biological Oceanography
Hood, Donald W., Ph.D., Director, Institute of Marine Science and Professor of Marine Science; Chemical Oceanography
Irving, Laurence, Ph.D., Advisory Scientific Director and Professor of Zoophysiology; Institute of Arctic Biology
Matthews, J. Brian, Ph.D., Associate Professor of Marine Science; Physical Oceanography
McRoy, Peter C., Ph.D., Assistant Professor; Biological Oceanography
Miller, Keith L., Ph.D., Associate Professor of Zoophysiology
Morrow, James E., Ph.D., Professor of Zoology, Ichthyology
Muench, Robin D., Ph.D., Assistant Professor; Physical Oceanography
Naidu, Angi S., Ph.D., Assistant Professor; Geological Oceanography
Reeburgh, William S., Ph.D., Assistant Professor; Chemical Oceanography
Rosenberg, Donald H., M.S., Associate Professor; Physical Oceanography
Royer, Thomas C., Ph.D., Assistant Professor; Physical Oceanography
Sharma, Ghanshyam D., Ph.D., Associate Professor; Marine Geology
Stone, David B., Ph.D., Associate Professor of Geophysics, Geophysical Institute

The University offers the M.S. degree in Ocean Engineering.

The program is coordinated by an interdisciplinary committee of the University composed of selected staff members from the academic colleges and research institutes involved in ocean science. At the M.S. level, the program emphasizes ocean-related course work in ocean engineering. However, additional graduate courses are recommended in the area of the student's undergraduate training to assure a high level of competence.

The minimum credit requirements for the M.S. degree

are 30 graduate credits (nine of which may be thesis credits). One summer of approved field work may be substituted for a thesis. Course requirements--OCN 620, OCE 670, OCE 672, OCE 674, and OCE 680, and a minimum of six credits of additional course work to be selected by the student's committee.

The following courses are offered in conjunction with this program:

ELECTRICAL ENGINEERING

E. E. 693	Special Topics (instrumentation)	arr.
E. E. 694	Special Topics (Electronics)	arr.

ENGINEERING MANAGEMENT

E. M. 605	Advanced Engineering Economy	3
E. M. 611	Engineering Management	3
E. M. 613	Engineering Management	3

CIVIL ENGINEERING

C. E. 603	Arctic Engineering	3
C. E. 620	Civil Engineering Const.	3
C. E. 631	Advanced Structural Analysis	3
C. E. 632	Advanced Structural Design	3
C. E. 644	Hydraulic Engineering	3
OCE 670	Waves and Tides	3
OCE 672	Underwater Acoustics	3
OCE 674	Environmental Hydrodynamics	3
OCE 676	Coastal Engineering	3
OCE 680	Ocean Engineering Field Work	3

The instructional staff for the courses listed above consists of the following:

Behlke, Charles E., Ph. D., Dean of College of Mathematics, Physical Sciences and Engineering; Professor of Engineering

Sackinger, William M., Ph. D., Associate Professor of Electrical Engineering; Institute of Arctic Environmental Engineering

Bennett, F. L., Ph. D., Associate Professor of Engineering

Shaw, David G., Ph. D., Assistant Professor; Marine Organic Chemistry

To obtain further information, address all inquiries directly to:

Dr. Donald W. Hood, Director
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

ALFRED UNIVERSITY
Alfred, New York 14802

The College of Liberal Arts of the University offers undergraduate preparation in the marine sciences and related fields within the context of majors in the standard disciplines and a recently-instituted major in environmental studies. The science departments are housed in modern buildings with adequate facilities for instruction and research. Faculty and students may also use the technical services and equipment of the New York State College of Ceramics at Alfred University. These facilities, housed in Binns-Merrill and McMahon Halls, include special laboratories for analyses by chemical, petrographic, spectroscopic, mass spectrometric, X-ray, and electron microscopic methods. The computer center, equipped with a Xerox Sigma 5 computer, is also available for use by students and faculty.

Through its membership in a four-college consortium (The College Center of the Finger Lakes, Corning, New York) the University has access to a lecture-laboratory building with an open docking facility on the west shore of Seneca Lake, several miles north of Watkins Glen. At present, the laboratory facilities are being enlarged, and year-round living accomodations constructed. Protected docking is available on the south shore of the lake. The Consortium maintains two 65-foot vessels (the R/V T-504 and R/V Lake Diver IV) suitable for work in depths up to 600 feet. A 25-foot harbor launch (Joy I) is useful for near-shore and estuarine exploration. The vessels are equipped with adequate power sources, winches, ship-to-shore communications, and navigational instruments. Scientific equipment includes dredges, fathometers, plankton collecting devices, nansen bottles, and on-board wet chemical laboratories.

Opportunity for work directly in the marine environment may be afforded by arrangements for study and/or research with cooperating institutions located in coastal areas and engaged directly in oceanographic teaching and research. Further such experience can be acquired via courses offered by the consortium (from December through May) on the Caribbean Island of San Salvador, through the courtesy of the Bahamian Government. A fully-equipped 50-foot converted liberty vessel (R/V Searcher I) is available for marine research at this facility. Additional opportunities for both course work and practical experience are available through Alfred University's association with Chapman College and its seagoing World Campus Afloat.

The B. A. degree is offered in the sciences, social sciences, and environmental studies. The Environmental Studies Major can be taken either independently or in conjunction with other programs. All programs consist of a number of modules designed to give the student a maximum number of choices in constructing a major.

The undergraduate major in environmental studies is designed for understanding, with the capacity for problem-solving available for those so talented or inclined. Some students will develop interest in career opportunities which relate to the aquatic aspects of the environmental, physical, or biological sciences. Graduate training is strongly recommended as optimal preparation for those so motivated.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BIOLOGY

311	Invertebrate Zoology	4
312	Biology of Lower Invertebrates	4
350	Aquatic Techniques	4
394	Ecology	4
410	Fresh Water Vertebrates	4
430	Problems in Ecology	4
445	Basic Limnology	4
450	Independent Study	4
490	Seminar	2
550	Research	HTBA

DEPARTMENT OF CHEMISTRY

250	Environmental Chemistry	4

DEPARTMENT OF GEOLOGY

105	Weather Elements	2
207	Stratigraphy & Sedimentation	2
221	Paleontology and Evolution	4
222	Paleontology and Evolution	4
332	Oceanography	4
450	Independent Study	HTBA

The instruction staff for the courses listed above consists of the following:

Barton, J. D., Jr., Ph. D., Professor of Biology (Provost)
Bowden, Bradley, Ph. D., Assistant Professor of Biology
Finlay, Peter S., Ph. D., Professor of Biology
Klingensmith, Clarence W., Ph. D., Professor of Chemistry
Rausch, James P., Ph. D., Assistant Professor of Biology
Rock, Barrett N., Ph. D., Assistant Professor of Biology
Rough, Gaylord E., Ph. D., Chairman and Professor of Biology
Rulon, Richard M., Ph. D., Professor of Chemistry
Sands, Richard D., Ph. D., Chairman and Professor of Chemistry
Sass, Daniel B., Ph. D., Chairman and Professor of Geology
Scholes, Samuel R., Jr., Ph. D., Professor of Chemistry
Shivley, Carl E., Ph. D., Assistant Professor of Biology
Taylor, James A., Ph. D., Associate Professor of Geography (Dean, College of Liberal Arts)
Webb, Michael W., Ph. D., Associate Professor of Physics

To obtain further information, address all inquiries directly to:

Mr. Nolan C. Cooper
Dean of Admissions & Records
Office of Admissions
Alfred University - Crandall Hall
P. O. Box 765
Alfred, New York 14802

ANNE ARUNDEL COMMUNITY COLLEGE
Arnold, Maryland 21012

In September 1973 the Ocean Engineering Technology Department will move into the new Careers Building, where it will occupy a combination oceanography lab and classroom and an ocean engineering lab. Facilities include a 250-cubic foot general purpose tank, a smaller acoustic test tank, and a small high pressure test station. The college has a field station and dock located on the Chesapeake Bay, a 26-foot diesel-powered research vessel and a 16-foot outboard sampling skiff. The selection of marine sampling and analysis instrumentation is complete.

Practical experience includes six one-day cruises aboard the R/V Ridgely Warfield operated by the Chesapeake Bay Institute. Field trips are conducted at marine research and engineering facilities in the Washington-Baltimore-Annapolis area.

Additional college facilities available to the Ocean Engineering Technology program include: a machine shop, a structure and strength of materials lab, an engineering materials lab, a data processing center, an electronics lab and a field biology center.

The college offers a two-year curriculum leading to an Associate in Arts degree in Ocean Engineering Technology with stong emphasis on technical subjects as a foundation for employment in ocean industry or government labs. The student has the option to emphasize either mechanical or electrical subjects.

Requirements for the degree include: 60 semester hours of credit exclusive of physical education; achievement of a cumulative quality point average of 2.00 or higher and completion of the following courses:

OET	111	General Oceanography	3
OET	114	Field Oceanography and Water Chemistry	4
OET	211	Instrumentation for Ocean Industry	4
OET	212	Ocean Engineering Technology	4
OET	214	Marine Science Technology Seminar	1
ENG	111	Composition & Intro. to Literature I	3
ENG	112	Composition & Intro. to Literature II	3
PHY	111	Fundamentals of Physics I	4
PHY	112	Fundamentals of Physics II	4
MATH	121	Algebra and Trigonometry	4
MATH	122	Math with Calculus I	4
MATH	123	Math with Calculus II	3
GT	112	Technical Communications	2
GT	111	FORTRAN	2

ELECTRICAL OPTION

EET	111	Fundamentals of Electronics	5
EET	112	Circuit Analysis	5
EET	211	Communications Circuits	5
EET	222	Control Circuits & Systems	4
EET	232	Electronic Design & Fabrication	3

MECHANICAL OPTION

MET	111	Engineering Graphics I	3
MET	112	Engineering Graphics II	3
MET	121	Manufacturing Process	3
MET	122	Intro. to Engineering Materials	3
MET	241	Statics and Strength of Materials	4
EET	291	Electricity I	3
EET	292	Electricity II	4

The instructional staff consists of the following:

ELECTRICAL ENGINEERING TECHNOLOGY

Litmatta, Peter E., M. Ed., Assistant Professor
Miller, Charles G., B. S. E. E., Assistant Professor
Smith, Robert J., M. S. E. E., Associate Professor
Theisz, Jr., Gordon F., M. E. E., Assistant Professor

MECHANICAL ENGINEERING TECHNOLOGY

Bowers, Richard H., M. S. M. E., Associate Professor
Lane, Sanford A., M. S. E. T., Assistant Professor
Somers, George W., M. S. M. E., Assistant Professor

OCEAN ENGINEERING TECHNOLOGY

Gucinski, Hermann, BA, Assistant Professor
Stibolt, Kenneth A., M. S. M. E., Assistant Professor

To obtain further information, address all inquiries to:

Kenneth A. Stibolt
Assistant Professor, Director
Ocean Engineering Technology
Anne Arundel Community College
101 College Parkway
Arnold, Maryland 21012

UNIVERSITY OF ARIZONA
Tucson, Arizona

Marine science activities at the University of Arizona

are focused primarily on the Gulf of California. An interdepartmental Marine Sciences Committee, headquartered in the Department of Biological Sciences, carries on an international, cooperative program with the Universidad de Sonora, Hermosillo, Mexico. The program has been in existence since 1958. The principal Mexican base of operations is the Puerto Penasco Marine Laboratory built by the Universidad de Sonora near Puerto Penasco, Sonora at the northern end of the Gulf of California. The laboratory is operated jointly by the two universities; it is located 219 road miles southwest of Tucson. Its facilities include 650 square feet of indoor laboratory space and reference collections, shaded outdoor sea tables, and large, plastic-lined pools excavated in the beach sand. The sea water system draws naturally filtered water from beach wells at a consistent termperature of 25°C ± 1°. The University of Arizona operates a nearby residence as a dormitory and classroom facility for visitors.

About six kilometers of shoreline in front of the marine laboratory and the classroom/dormitory have been set aside as a preserve under the joint administration of the two universities, for teaching and research purposes. Tidal variations exceeding 20 feet provide exposure of rich biotas in a diversity of littoral environments within a short distance of the marine laboratory. Small boats are available, but no major seagoing vessels are maintained.

The following degrees are offered:

1. M.S. in Biology, Botany or Zoology, Department of Biological Sciences. Students majoring in marine biology may elect to take the master's degree in either biology, botany or zoology. Intended candidates for the M.S. must present a minimum of about 32 hours of undergraduate preparation in biological sciences equivalent to the requirements for an undergraduate major in this department. They should have completed two years of chemistry (inorganic and organic), mathematics, through beginning calculus, and a year of physics. Deficiencies in undergraduate preparation must be made up. An official record of the student's performance in the Graduate Record Examination (Aptitude and Advanced Test in Biology), a full transcript of undergraduate course work, and three letters of recommendation are required of all applicants. The student must complete 30 graduate credit units in an approved graduate study program. Both thesis and non-thesis M.S. programs are available.

2. Ph.D. in Biology, Botany or Zoology, Department of Biological Sciences. Students majoring in marine biology may elect to take the doctorate degree in either biology, botany or zoology. Intended candidates for the Ph.D must present undergraduate coursework as for the M.S. degree. GRE scores, transcripts, and letters of recommendation as described for the M.S. degree are required of all applicants. In addition to the major, a suitable minor area must be selected, and the student must complete an approved, individually-planned graduate study program including course work in the minor field. An approved dissertation problem is required of all students, and each must pass qualifying, preliminary and final oral examinations, and demonstrate achieved proficiency in one foreign language.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

DEPARTMENT OF BIOLOGICAL SCIENCES

240	Oceanography	2
240L	Oceanography Laboratory	2
242	Marine Ecology	5
245	Aquatic Resource Biology	2
245L	Aquatic Resource Biology Laboratory	2
266	Comparative Physiology	4
276	Marine Algae	3
280	Invertebrate Zoology	4
282	Ichthyology	4
290	Animal Behavior	2
299	Special Problems	1-5
299b	Problems in Applied Marine Biology	2

DEPARTMENT OF ATMOSPHERIC SCIENCES

221	Physical Climatology	3
227	Bioclimatology	3

DEPARTMENT OF GEOSCIENCES

218	Sedimentary Environments	3

HYDROLOGY AND WATER RESOURCES PROGRAM
(Inter-departmental)

281	Physical Oceanology and Limnology for Hydrologists	2

DEPARTMENT OF AGRICULTURAL CHEMISTRY AND SOILS

265	Hydrochemistry	3

GRADUATE

DEPARTMENT OF BIOLOGICAL SCIENCES

340	Advanced Studies in Marine Biology	2
400	Research	1-8
410	Thesis	1-8
420	Dissertation	1-9

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGICAL SCIENCES

Baldwin, Howard A., M.S., Research Associate
Barnard, J. Laurens, Ph.D., Research Associate and Curator of Crustecea, Smithsonian Institution Systematics and Biology of Amphipods
Brusca, Rochard M., M.S., Research Associate and Resident Marine Biologist, Puerto Penasco
Carlson, John S., Ph.D., Assistant Professor
Hendrickson, John R., Ph.D., Professor
Hoshaw, Robert W., Ph.D., Professor
Mead, Albert R., Ph.D., Professor
Miller, Walter B., Ph.D., Assistant Professor and Curator of Invertebrates
Pickens, Peter E., Ph.D., Associate Professor
Russell, Stephen M., Ph.D., Associate Professor and Curator of Birds
Thomson, Donald A., Ph.D., Associate Professor and Curator of Fishes
Ziebell, Charles D., M.S., Lecturer and Assistant Leader, Arizona Cooperative Fishery Unit

DEPARTMENT OF ATMOSPHERIC SCIENCES

Hastings, J. Rooney, Ph.D., Professor
Sellers, William D., Ph.D., Professor

DEPARTMENT OF GEOSCIENCES

Schreiber, Joseph F., Jr., Ph.D., Professor

HYDROLOGY AND WATER RESOURCES PROGRAM
(Inter-departmental)

Simpson, Eugene S., Ph.D., Professor

DEPARTMENT OF AGRICULTURAL CHEMISTRY AND SOILS

Dutt, Gordon R., Ph.D., Professor

To obtain further information about the above programs all inquiries should go to:

Dr. J. R. Hendrickson
Coordinator, Marine Sciences
Department of Biological Sciences
The University of Arizona
Tucson, Arizona 85721

The following degrees are also offered:

1. Ph. D. in Geological Engineering. Candidates specializing in ocean engineering may obtain a Doctor of Philosophy in Geological Engineering. A suitable minor and an approved dissertation project are required by the department. The candidate will also be required to demonstrate proficiency in one foreign language and to complete approved courses in statistics and computer techniques.

2. M. S. in Geological Engineering. Candidates for a Master of Science in Geological Engineering specializing in ocean engineering, will be required to complete 30 units including a thesis and to pass a final examination covering both the thesis and course work.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF MINING AND GEOLOGICAL ENGINEERING

GEOLOGICAL ENGINEERING

206	Engineering Geology	3
208	Ocean Engineering	3
220	Geophysical Exploration	3
238	Design of Exploration Programs	3
399	Seminar	1-3
410	Thesis	1-8
420	Dissertation	1-9

MINING ENGINEERING

231	New Techniques in Mining	2

The instructional staff for the courses listed above consists of the following:

Abel, John F., D.Sc., Associate Professor
Lacy, Willard C., Ph.D., Professor
Peters, William C., Ph.D., Professor

To obtain further information, address all inquiries to:

Dr. Willard C. Lacy
Deptment of Mining and Geological Engineering
The University of Arizona
Tucson, AZ 85721

BOSTON UNIVERSITY
MARINE BIOLOGICAL LABORATORY
Woods Hole, Massachusetts 02543

The Boston University Marine Program (BUMP) is a program in marine biological sciences primarily for graduate students but open to a small number of selected undergraduates. It includes the following:

Basic courses in marine biology presented annually during the academic year (September-May) by BUMP faculty in residence at the Marine Biological Laboratory at Woods Hole.

Seminars in marine biology with the participation of BUMP faculty and visiting marine scientists.

Opportunities for research and for research training in marine problems, made possible by the availability of facilities at MBL, on campus in Boston and at the New England Aquarium in Boston.

Opportunities for qualified graduate students from other institutions to take courses and seminars in BUMP on a "leave of absence" basis from their home institution with academic credit available for transfer from the Boston University Graduate School.

Courses in marine biology for undergraduates are in the planning stage for 1973-74 and thereafter.

A 65-foot vessel, the R/V. A. E. Verrill, and the library of MBL, among the finest marine biological libraries in the country, are available to BUMP students.

The following degrees are offered:

A.M. in Biology, specializing in marine biology, requiring eight graduate-level semester courses (32 credit hours), presentation of a master's thesis and a reading knowledge of one major foreign language (french, german or russian).

Ph.D. in Biology; specializing in marine biology, requiring successful completion of eight graduate-level semester courses (32 credit hours) beyond the A.M., a reading knowledge of one major modern foreign language (if not already demonstrated for the A.M.), successful completion of qualifying examination, and presentation of a Ph.D. thesis, with oral examination.

The following six-week intensive courses are offered:

BI 727X	Marine Invertebrate Zoology	6
BI 729X	Marine Ecology	6
BI 725X	Ichthyology	6
BI 781X	Seminar in Marine Biology	2
BI 783X	Seminar in Marine Biology	2
BI 935X	Research in Marine Biology	--
BI 730X	Environmental Physiology	6
BI 732X	Marine Microphytes	6
BI 782X	Seminar in Marine Biology	2
BI 784X	Seminar in Marine Biology	2
BI 936X	Research in Marine Biology	--

In addition, on campus in Boston the following related courses are offered:

BI 415	Marine Botany	4
GG 541	Oceanography	4
GL 503	Marine Geology	4
GL 533	Marine Paleoecology	4
BI 520	Topics in Marine Zoology	4

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Humes, Arthur G., Ph.D., Professor
Lang, Frederick, Ph.D., Assistant Professor
Read, Kenneth R.H., Ph.D., Associate Professor
Tiffney, Wesley N., Professor
Valicla, Ivan, Ph.D., Assistant Professor

GEOGRAPHY

Batchelder, Robert B., Ph.D., Professor

GEOLOGY

Brownlow, Arthur H., Ph.D., Associate Professor
Caldwell, Dabney W., Ph.D., Associate Professor
Cameron, Barry W., Ph.D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Arthur G. Humes, Director
Boston University Marine Program
Marine Biological Laboratory
Woods Hole, Massachusetts 02543

BOWLING GREEN STATE UNIVERSITY
Bowling Green, Ohio 43403

Bowling Green State University offers courses in

marine science within the framework of the Departments of Biology and Geology.

The Department of Biology is located in a modern, seven-year-old Life Sciences Building which is well equipped with research and teaching instruments and facilities commensurate to a Ph. D. degree-granting department. The facilities include a sizeable marine laboratory equipped with numerous fiberglass aquaria of 10, 30, and 250 gallon capacity, pH meters, precision balance, refractometer, temperature control incubators, refrigerators and a freezer. Additional equipment for research projects is available in the department. The department offers a number of aquatic oriented courses including a marine biology course with field trip and various marine seminars. The university is affiliated with the Gulf Coast Research Laboratory, Ocean Springs, Mississippi and with its summer courses in addition to those in the department, students can gain a background in marine biological science.

The Department of Geology maintains a marine science laboratory with aquariums and other equipment essential to growing small organisms. The department also has a paleobiology laboratory for the study of fossils, a sedimentology laboratory, a geochemistry laboratory, and an x-ray analysis facility. Research equipment includes grab samplers and coring devices, salinometer, portable pH meters, underwater photographic equipment, wet suits, water test outfits, sieve sets, plankton nets, settling tube, refrigerators, microscopes and photomicrographic equipment, microorganism culture equipment, and 11-foot boat with motor. The department maintains a houseboat as a field station at the Newfound Harbor Marine Institute, Big Pine Key, Florida. The marine geology course includes a two-week field trip to the marine environment, and a summer field course in modern marine environments is offered.

The departments of biology and geology offer both the B. S. and the M. S. with concentrations in marine science. The following degrees are offered:

1. B. S. in Biology. Requirements: 48-50 quarter hours (minimum) in biology, organic chemistry with laboratory required and biochemistry, calculus and physics recommended.
2. B. S. in Geology. Requirements: a student may elect to specialize in paleoblology.
3. M. S. in Biology or Geology. Requirements: 45 quarter hours minimum degree program and a formal thesis.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Bio	106	General Botany	3
Bio	107	General Zoology	3
Bio	208	Basic Physiology	5
Bio	213	Environmental Biology	5
Bio	251	General Genetics	5
Bio	401	Introduction to Biological Research	3-6
Bio	405	General Parasitology	5
Bio	408	Animal Physiology	5
Bio	409	Invertebrate Zoology I	5
Bio	410	Invertebrate Zoology II	5
Bio	413	Bacteriology	5
Bio	424	Algology	5
Bio	425	Limnology	5
Bio	431-433	Morphogenesis of Vertebrates I. Development, II. and II. Comparative Anatomy.	15
Bio	436	Cytology	5
Bio	472	Ichthyology	4
Bio	474	Marine Biology (inc. Field Trip)	5
Bio	478-487	Courses at Gulf Coast Research Lab	
Bio	490	Seminar: Topics in Marine Biology	2
Geo	302-303	Invertebrate Paleontology	8
Geo	307-308	Sedimentary Petrology and Stratigraphy	6
Geo	310	Geomorphology	4
Geo	480	Seminar in Geology	3
Geo	490	Geological Problems	1-4
Geo	412	Advanced Historical Geology	4
Geo	431	Introduction to Geochemistry	4
Geo	432	Geophysics	3
Geo	433	Stratigraphic Chorology	4
Geo	472	Marine Geology and Paleobiology	4
Geo	496	Field Course in Modern Marine Environments	9

GRADUATE

Geo	512	Sedimentology	5
Geo	513	Sedimentary Petrography	5
Bio	515	Comparative Physiology	5
Bio	516	Protozoology	5
Geo	523	Analysis of Sedimentary Structures	4
Geo	529	Advanced Invertebrate Paleontology	5
Geo	533	Paleoecology	5
Geo	535	Micropaleontology	5
Geo	538	Geochemistry of Sediments	5
Geo	540	Pleistocene Geology	5
Geo	546	X-ray Analysis	5
Geo	550	Research Seminar	1-5
Geo	551	Seminar in Invertebrate Paleobiology	3-5
Geo	552	Seminar in Paleobiology of Microorganisms	3-5
Geo	555	Seminar in Paleoecology	3-5
Geo	556	Seminar in Marine Sedimentation	3-5
Geo	557	Seminar in Geochemistry of Diagenesis	3-5
Geo	558	Seminar in Geomorphology and Pleistocene Geology	3-5
Bio	577	Problems in Marine Zoology	5-9
Geo	593	Advanced Field Geology	1-9
Geo	598	Research Problems	1-5
Geo	599	Thesis Research	1-9

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Acker, G. Gerald, Sc. D., Professor
Brent, Morgan M., Ph. D., Professor
Crang, Richard E., Ph. D., Associate Professor
Groat, Cynthia S., M. A., Instructor
Hallberg, Carl W., Ph. D., Associate Professor
Harmon, Shirley A., Ph. D., Associate Professor
Lowe, Rex L., Ph. D., Assistant Professor
Martin, Elden W., Ph. D., Associate Professor
Oster, Irwin I., Ph. D., Professor
Rabalais, Francis C., Ph. D., Associate Professor
Schurr, Karl M., Ph. D., Associate Professor

GEOLOGY

Floyd, Jack C., M. A., Instructor
Hoare, Richard D., Ph. D., Professor
Kahle, Charles F., Ph. D., Professor
Owen, Donald E., Ph. D., Associate Professor
Steinker, Don C., Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Mrs. Cynthia S. Groat
Department of Biology
Bowling Green State University
Bowling Green, Ohio 43403
(419) 372-2058

BRAZOSPORT COLLEGE
500 College Drive
Lake Jackson, Texas 77566

Regular classrooms average 576 square feet in area

and are utilized on a flexible basis, i.e., drafting classroom, equipped with drafting tables and stools are utilized for navigation classes, electronics laboratory and classrooms for marine electronics, etc., contingent upon project needs and classroom laboratory availability. Office space specifically assigned to the project is programmed at 96 square feet and laboratory-bay areas at 3,072 square feet. Equipment in the categories of navigational, seamanship, fisheries, engineering, marine electronics, diving, fire fighting, furniture and text and reference material are available to the project.

Training vessels include the Big M and the Lady Anna which are 65-foot steel-hull, twin-diesel vessels. The Miss Freeport, a 135-foot industrial type vessel is also used.

Continuation in the program for the second year will lead to an Associate of Applied Science degree; the summer is encouraged for certificate program students and required in the degree program.

The following courses are offered in connection with the above program.

Ocea 102	Oceanography I	2
Ocea 104	Seamanship I	4
Ocea 124	Navigation I	4
Ocea 103	Oceanic and Marine Tech I	3
Ocea 123	Marine Engineering Tech I	3
Ocea 114	Seamanship II	4
Ocea 134	Navigation II	4
Ocea 113	Oceanic and Marine Tech II	3
or		
Ocea 133	Marine Industrial Applications	
Elect 133	Marine Electronics	3
Math 173	Technical Math I	3
Ocea 106	Oceanic and Marine Tech III	6
Ocea 202	Oceanography II	2
Ocea 203	Seamanship III	3
Bus 113	Business Communications	3
Math 183	Technical Math II	3
Phy 204	Technical Physics I	4
Ocea 213	Seamanship IV	3
Ocea 223	Marine Engineering Tech II	3
Ocea 244	Oceanic and Marine Tech IV	4
or		
Ocea 254	Marine Industrial Applications II	
Phy 214	Technical Physics II	4
Ocea 263	Marine Resources	3

Full time instructors in the Department of Oceanic and Marine Technology:

John G. Gunning, B.S., Assistant Professor
E. D. Middleton, B.S., Assistant Professor

To obtain further information, address all inquiries directly to:

Mr. E. D. Middleton, Director
Oceanic and Marine Technology
Brazosport College
500 College Drive
Lake Jackson, Texas 77566
Tele: (713) 265-6131

UNIVERSITY OF BRITISH COLUMBIA
Vancouver 8, B. C., Canada

The Institute of Oceanography is a part of the Faculty of Graduate Studies of the University of British Columbia and provides facilities for work toward the Master of Science and Doctor of Philosophy degrees in the marine aspects of the basic sciences. Offices and laboratories are on the university campus at Point Grey about six miles west of the centre of Vancouver. Field work is carried out on research vessels made available by federal government agencies from the 40-meter C.S.S. Vector to the 77-meter C.N.A.V. Endeavor. Facilities are available for work in botany, chemistry, geology, geophysics, mathematics, physics and zoology. The present research emphases are on coastal and fjord estuary studies, air/sea interaction and structure of the continental shelf and slope. The institute has a PDP-12 computer and the university has an IBM 360/67.

The following degrees are offered:

1. M.S. in botany, chemistry, geology, geophysics, mathematics, physics or zoology:

a. Entrance requirement is an honours B.S. in the appropriate field.
b. Fifteen units of credit including six for thesis research (one unit of credit is given for a 25-hour lecture course).
c. Comprehensive examination in some departments.
d. Research and thesis.
e. Language requirement - reading knowledge of one foreign language if required by supervising committee.

2. Ph.D. in the same fields:

a. Entrance requirement is a master's degree, or a bachelor's degree with first class honours standing, or a successful first graduate year on a master's program with clear evidence of research ability.
b. Courses as required by supervising committee (minimum of fifteen units if directly from B.S. degree including first class average for nine units minimum in first year).
c. Comprehensive examination in most fields.
d. Original research and presentation of thesis.
e. Language requirement as determined by supervising committee.
f. Public examination and defence of thesis.

Although there is no formal program in ocean engineering yet, some graduate students in civil, electrical, and mechanical engineering are proceeding on marine oriented M.A.S., and Ph.D. programs in the Faculty of Applied Science in conjunction with the Institute of Oceanography.

Degree recipients in recent years:

	M.S.	Ph.D.
1971	1	4
1972	6	5

The following courses are offered:

UNDERGRADUATE COURSES

OCEANOGRAPHY

400	Introduction to Synoptic Oceanography	1
401	Introduction to Dynamic Oceanography	1
402	Introduction to Chemical Oceanography	1
403	Introduction to Biological Oceanography	1
404	Introduction to Geological Oceanography	1

GRADUATE COURSES

OCEANOGRAPHY

501	Advanced Synoptic Oceanography	1
502	Advanced Chemical Oceanography	1
503	Oceanographic Methods	1
505	Special Advanced Course	1-3
506	Marine Phytoplankton	1
507	Zooplankton Ecology	1
508	Air-Sea Transfer Processes	1
509	Biological Oceanographic Mechanisms	1

BOTANY

510	Marine Phycology	3

512	Practical Marine Phytoplankton Study	2
517	Aquatic Mycology	3

ZOOLOGY

511	Advanced Marine Zooplankton	2

GEOLOGY

519	Seminar in Sedimentology	1.5
520	Problems in Sedimentology	1.5

PHYSICS

537	Advanced Dynamic Oceanography	1
538	Fluid Mechanics	1
539	Waves and Tides	2
540	Turbulence	2
441	Introductory Meteorology	1
541	Dynamic Meteorology	1
542	Waves in Rotating Fluids	1

(The figures to the right of the page indicate the unit value of the course. One unit represents one lecture per week for the winter session of 25 weeks, or the equivalent.)

The instructional staff in the Institute includes:

BOTANY

Hughes, G. C., Ph. D., Associate Professor
Scagel, R. F., Ph. D., Professor
Taylor, F. J. R., Ph. D., Associate Professor

CHEMISTRY

Grill, E. V., Ph. D., Assistant Professor

GEOLOGY

Chase, R. L., Ph. D., Associate Professor
Mathews, W. H., Ph. D., Professor
Murray, J. W., Ph. D., Associate Professor

GEOPHYSICS

Clowes, R. M., Ph. D., Assistant Professor

MATHEMATICS

Mysak, L. A., Ph. D., Associate Professor

PHYSICS

Burling, R. W., Ph. D., Professor
Cameron, W. M., Ph. D., Honorary Professor
LeBlond, P. H., Ph. D., Associate Professor
Miyake, M., Ph. D., Associate Professor
Pickard, G. L., D. Phil., Professor
Pond, G. S., Ph. D., Associate Professor
Stewart, R. W., Ph. D., Honorary Professor

ZOOLOGY

Lewis, A. G., Ph. D., Associate Professor
Parsons, T. R., Ph. D., Professor

To obtain further information, address enquiries to:

Dr. G. L. Pickard, Director
Institute of Oceanography
The University of British Columbia
Vancouver 8, B. C., Canada
Phone: (604) 228-2482

BROWN UNIVERSITY
Providence, Rhode Island 02912

Research and training in the marine sciences is undertaken at Brown in the Department of Geological Sciences. In addition to programs within the department, a cooperative effort in the marine sciences exists between Brown University and the Woods Hole Oceanographic Institution. As needed by individual students, cooperative programs of study and research programs operated jointly by Brown, Lamont-Doherty Geological Observatory and Oregon State University, the student has access to extensive collections of deep-sea cores. Ocean-going research is conducted with Woods Hole Oceanographic Institution.

Degrees offered:

A. B., Sc. B., in Marine Sciences. This is an independent concentration program structured in consultation with the departmental undergraduate advisor. Courses from chemistry, biology, geology, and physics are included (three recipients in 1972).

M. Sc. in Geological Sciences, specializing in marine sciences. Requirements: Successful completion of an integrated program including a minimum of eight semester courses, no more than two of which shall be research courses, and demonstration of research capability (two recipients in 1972).

Ph. D. in Geological Sciences, specializing in Marine Sciences. Requirements: Successful completion of course work on original thesis research and demonstration of language proficiency (three recipients in 1972).

UNDERGRADUATE

Geol	7	Introduction to the Ocean	4
Geol	28	Pollution and the Environment	4
Geol	112	Oceanic Paleoecology	4
Geol	121	Oceanography	4
Geol	191, 192	Undergraduate Research	4

GRADUATE

Bio	284	Vertebrate Paleontology	4
Geol	219, 220	Seminar in Micropaleontology	4
Geol	223	Advanced Sedimentary Petrology	4
Geol	291	Special Topics	4
Geol	211	Thesis Research	4

The Instructional Staff

Biology
Quevedo, Walter, Ph. D., Professor

Geology
Imbrie, John Ph. D., Professor
Berggren, William Ph. D., Professor
Matthews, Robley Ph. D., Professor
Giletti, Bruno Ph. D., Professor

UNIVERSITY OF CALIFORNIA

Instruction on marine related topics are available on all interdepartmental UC campuses. However, degree programs in marine science are offered only at Berkeley (undergraduate major in marine biology) and at San Diego (graduate instruction leading to M. S. and Ph. D. in oceano-

graphy, marine biology and earth sciences at Scripps Institution of Oceanography).

Since course credits are transferable by consent we are listing all UC campuses offering marine-related instructions. There are University of California entries for Berkeley, Bodega Marine Lab, Davis, Irvine, Los Angeles, Riverside, Santa Barbara, Santa Cruz and Scripps. One additional course is offered at Hastings College of Law, an affiliated unit of the University of California, on "Law of the Sea," two credit hours. Inquiries about this may be directed to Dr. Richard B. Glickman, Hastings College of Law, 198 McAllister Street, San Francisco, CA 94102

UNIVERSITY OF CALIFORNIA
Berkeley, California 94720

UC Berkeley offers marine-related programs in biology and in engineering. In the life sciences, instruction and research are shared between the Berkeley campus and the Bodega Marine Laboratory (BML). Oceanographic research vessels are available in the bay area through arrangements with the U.S. Geological Survey and the U.S. Bureau of Mines, and in San Diego through the marine facilities of Scripps Institution of Oceanography.

An undergraduate major in marine biology is offered by the Department of Instruction in Biology on the Berkeley campus. Lower division courses: ten specified science courses. Upper division courses: 14 specified courses, one quarter course or summer course (4 unit minimum) at a marine laboratory is required, additional units to complete a minimum of 45 units in upper division work in the major. Graduate degrees (M.A. and Ph.D.) with emphasis on courses and research in marine fields are offered by the Department of Botany and Zoology and others. The university herbarium houses the largest collection of marine algae in the United States.

In engineering disciplines, extensive facilities are associated with the Berkeley campus and the nearby Richmond Field Station. A partial listing follows: Hydraulic Engineering Laboratory-deep wave channel; wind-wave tank, basin, and channel; wave and towing tank; model basins; sediment samplers, and electronic analog-to-digital converter (HYDRA system). Naval Architecture Laboratory-model towing tank, ship impact machine, and ship structure test machine. Sanitary Engineering Research Laboratory-treatment and reclamation of industrial and domestic wastes, and apparatus for study of water pollution problems related to radio-active wastes, water resources, and air pollution. Sea Water Conversion Laboratory- experimental unit for demineralizing seawater through solar distillation, electrodialysis, reverse osmosis, and ion exchange methods. Soil Mechanics Laboratory-strength testing with universal testing machine (four million-ton capacity), strain loading machine, triaxial compression cells, shaking table, earthquake loading machine, and eight-channel oscillograph. Structural Engineering Materials Laboratory-study behavior under load of structures and models using elastic displacement, strain measurement, moire-effect, and photoelastic methods, control rooms provide wide range of temperature and humidity parameters.

Access to the U.S. Corps of Engineers Bay Model, Sausalito, and U.S. Geological Survey Pacific Coast Marine Geology, Menlo Park are offered.

No one particular engineering discipline includes all the ramifications of ocean engineering. As a consequence, there is no department of ocean engineering, and no degree in ocean engineering as such. Ocean engineering is a graduate option in several of the established departments in the College of Engineering. Students specializing in ocean engineering may obtain either a scientific or a professional degree, depending on the emphasis of the program they pursue. The degrees, Master of Science and Doctor of Philosophy in Engineering or Engineering Science, are granted upon completion of programs emphasizing theory, research and design; the professional degrees, Master of Engineering and Doctor of Engineering, are granted upon completion of programs emphasizing economic and technical problems arising in the professional practice of engineering.

The Ocean Engineering Program within the College of Engineering includes the following departments: Civil Engineering, Materials Science and Engineering, Mechanical Engineering and Naval Architecture. The Institute of Marine Resources sponsors research in inorganic marine resources, chiefly on the chemical and geological properties of ocean-bottom sediments in cooperation with the Ocean Engineering Program.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF CIVIL ENGINEERING

CE	201A	Physical Oceanology	3
CE	201B	Chemical Oceanology	3
CE	201C	Geological Oceanology	3
CE	205A	Coastal Engineering	3
CE	205B	Coastal Engineering	3
CE	206A	River Hydraulics and Sedimentation	3
CE	206B	River Hydraulics and Sedimentation	3
CE	206C	River Hydraulics and Sedimentation	3
CE	207	Advanced Hydraulic Design	3
CE	208	Advanced Hydraulic-Structures Laboratory	2
CE	226	Random Vibrations of Structural Systems	4

DEPARTMENT OF MECHANICAL ENGINEERING

ME	164	Engineering Aero-and Hydro-Dynamics	4
ME	262	Theoretical Hydrodynamics	4
ME	263A	Viscous Fluid Flow	4
ME	263B	Viscous Fluid Flow	4
ME	270A	Geophysical Fluid Mechanics	3
ME	270B	Geophysical Fluid Mechanics	3
ME	270C	Geophysical Fluid Mechanics	3
ME	290K	Turbulence	3
ME	290N	Corrosion	4
AM	283	Wave Propagation in Elastic Media	4
AM	290C	Acoustic Wave Propagation	3
AM	290E	Selected Topics in Wave Propagation in Anelastic Materials	4

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

E	200	Applied Geophysics	4
E	204	Electrical, Magnetic, and Gravity Methods	5
EG	290A	Electronic Instrumentation in Geophysical Engineering	3

DEPARTMENT OF NAVAL ARCHITECTURE

NA	151	Statistics of Naval Architecture	3
NA	152A	Ship Resistance and Propulsion	3
NA	152B	Ship Dynamics	3
NA	153	Marine Engineering	5
NA	154A	Ship Design	3
NA	154B	Ship Design	3
NA	240A	Theory of Ship Structures	3
NA	240B	Theory of Ship Structures	3
NA	240C	Theory of Ship Structures	3
NA	241A	Hydrodynamics of Ships	3
NA	241B	Hydrodynamics of Ships	3
NA	241C	Hydrodynamics of Ships	3
NA	242	Advanced Ship Design	3
NA	290	Advanced Graduate Study in Naval Architecture	3-16

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BOTANY

West, Hohn, A., Ph.D., Associate Professor

DEPARTMENT OF CIVIL ENGINEERING

Clough, R. W., Jr., Sc.D., Professor of Civil Engineering
Duncan, J. M., Ph.D., Assistant Professor of Civil Engineering
Einstein, H. A., D.S.T., Professor of Hydraulic Engineering
Fischer, H. B., Ph.D., Assistant Professor of Hydraulic Engineering
Horne, A. J., Ph.D., Assistant Professor of Sanitary Engineering
Johnson, J. W., M.S., Professor of Hydraulic Engineering, Director of Hydraulic Engineering Lab.
Kaufman, W. J., Professor of Sanitary and Radiological Engineering, Director of Sanitary Engineering Research Lab.
Lin, T. Y., M.S., Professor of Civil Engineering
Lysmer, J., Ph.D., Assistant Professor of Civil Engineering
McGuahey, P. H., M.S., Professor of Sanitary Engineering and Public Health, Emeritus
Mitchell, J. K., Sc.D., Associate Professor of Civil Engineering
Moffitt, F. H., M.C.E., Professor of Civil Engineering
Oswald, W. J., Ph.D., Professor of Sanitary Engineering
Pearson, E. A., Sc.D., Professor of Sanitary Engineering, Chairman, Division of Hydraulic and Sanitary Engineering
Penzien, J., Sc.D., Professor of Civil Engineering
Seed, H. B., Ph.D., Professor of Civil Engineering, Chairman, Department of Civil Engineering
Selleck, R. E., Ph.D., Associate Professor of Sanitary Engineering
Thomas, J. F., Ph.D., Professor of Sanitary Engineering
Wiegel, R. L., M.S., Professor of Civil Engineering
Wilde, P., Ph.D., Assisant Professor of Hydraulic Engineering and Research Oceanographer, Institute of Marine Resources
Witherspoon, P. A., Ph.D., Professor of Geological Engineering

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Fuerstenau, D. W., Sc.D., Professor of Metallurgy
Morrison, H. F., Ph.D., Associate Professor of Geological Engineering
Rodgers, P., Ph.D., Assistant Professor of Geophysical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Corcos, G. M., Ph.D., Professor of Aeronautical Sciences
Cornet, I., Ph.D., Professor of Mechanical Engineering
Holt, M., Ph.D., Professor of Aeronautical Sciences
Howe, E. D., M.S., Professor of Mechanical Engineering, Emeritus
Laird, A. D. K., Ph.D., Professor of Mechanical Engineering, Director of Sea Water Conversion Lab
Laitone, E. V., Ph.D., Professor of Aeronautical Sciences
Sherman, F. S., Ph.D., Professor of Aeronautical Sciences
Spiegler, K. S., Ph.D., Professor of Mechanical Engineering

DEPARTMENT OF NAVAL ARCHITECTURE

Paulling, J. R., Jr., D.Eng., Professor
Schade, H. A., Dr. Ing. Professor Emeritus
Sibul, O. J., M.S., Lecturer
Webster, W. M., Ph.D., Acting Associate Professor
Wehausen, J. V., Ph.D., Professor of Engineering Science, Chairman, Department of Naval Architecture

DEPARTMENT OF PALEONTOLOGY

Arnold, Zach M., Ph.D., Professor
Berry, William B. N., Ph.D., Professor

DEPARTMENT OF ZOOLOGY

Ghilelin, Michael T., Ph.D., Assistant Professor
Hand, Cadet H., Ph.D., Professor
Pressick, M. L., Ph.D., Assistant Professor
Smith, Ralph M., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Professor O. Wilde, Chairman
Committee on Engineering in the Ocean Environment
College of Engineering
University of California
Berkeley, California 94720

-OR-

J. A. West
Department of Botany
University of California
Berkeley, California 94720

UNIVERSITY OF CALIFORNIA
BODEGA MARINE LABORATORY
Bodega Bay, California 94923

The Bodega Marine Laboratory (BML) is a research and teaching facility of the University of California. It is not a degree granting part of the university although it provides support for degree programs offered by the academic departments of the Berkeley and Davis campuses. Courses in support of degree programs are offered at BML and graduate students are in full time residence carrying on thesis research. Admission of students to the degree programs is controlled by the academic departments and Graduate Division of the regular university campuses.

The laboratory is situated on a 326-acre biological refuge located on the outer coast of Bodega Head; the property includes more than a mile of rocky shoreline, short stretches of sandy beach, and mixed mud and sand flats in Bodega Harbor. The laboratory building houses 25 modern research laboratories and two teaching laboratories. Equipment and facilities are available for work in biochemistry, physiology, developmental biology, microbiology, ecology, botany, zoology, and marine geology. The laboratory is provided with running raw and filtered sea water which is pumped directly from the ocean. A large aquarium room contains numerous water tables and aquaria, the latter up to 1,000 gallons. Special facilities include dark rooms (some equipped with running sea water), constant temperature rooms, an electron microscope and a well equipped machine and wood shop. Three inboard powered vessels ranging from 22 to 38 feet are available to support shallow water and near shore research as well as several outboard powered boats for work in the harbor or nearby estuaries.

The degrees of Master of Arts and Doctor of Philosophy in botany, geology and zoology are offered by the Departments of Botany, Geology and Zoology of the Berkeley and Davis Campuses for research carried out at the Bodega Marine Laboratory. Courses at the laboratory are credited toward degree work on these and other campuses of the University of California.

Degrees granted in 1971-72:

Ph. D. in zoology	10
Ph. D. in botany	1
M. A. in geology	2
M. A. in engineering	1

The following courses are offered at BML in conjunction with the degree programs:

UNDERGRADUATE COURSES

Botany 104
Marine Botany (10 units) Full time study in the first six weeks of the summer session, including lectures, laboratory, field trips and individual study on the morphology, physiology and development of marine algae. The experimental approach to the study of benthic and planktonic forms will be emphasized. Full time residence at the laboratory is required.

Geology 119
Paleoecology and Marine Geology of the Continental Shelf (nine units) Full time study during the second six weeks of the summer session. Field and laboratroy study of physical and biological aspects of the modern marine environment, and of the geology and paleobiology of marine sedimentary rocks in nearby coastal areas. Full time residence at the laboratory is required.
Prerequisites: One college course in geology or biology, and consent of instructors. Limited enrollment.

Zoology 142
Marine Ecology (10 units) Full time study in the second six weeks of the summer session. Lectures, laboratories and field work. Physical, chemical and biological factors and their relationship to the distribution of marine organisms and community structure.
Prerequisites: A course in general ecology. Limited enrollment.

Zoology 157
Biology of Marine Invertebrates (10 units)
Full time study in the first six weeks of the summer session, including lectures, laboratory, field trips, and individual study of marine invertebrates. Full time residence at the laboratory is required.
Prerequisites: Biology 1A-B-C or 11A-B or consent of instructor; an alternate to Zoology 108. Limited enrollment.

Interdepartmental Studies 100
Problems in Marine Biology (15 units) Full time study at the Bodega Marine Laboratory for the 10-week spring quarter. Lectures, laboratories and field work with directed study on selected topics stressing experience in original research.
Prerequisites: Basic biology courses plus consent of instructors.

GRADUATE COURSES

Geology 219
Special Studies in Paleoecology and Marine Geology (six to nine units) Full time study in the second six weeks of the summer session. Independent field and laboratory investigation of selected subjects within the marine realm. An original research project and final report. Full time residence at the laboratory required.
Prerequisites: Geology 119 or graduate standing, and consent of instructors. Limited enrollment.

Zoology 229
Seminar in Marine Biology (2 units) Topics vary from year to year. Offered in the winter quarter for students at BML.

Zoology 257
Advanced Biology of Marine Invertebrates (5 units)
Full time study in the first six weeks of the summer session, including lectures, seminar discussions, and individual study of selected problems on marine invertebrates. Full time residence at the laboratory is required.
Prerequisites: Zoology 157 or 108 or equivalent and consent of instructor.

The instructional staff for the courses listed above consists of the following:

Ghiselin, Michael, Ph. D., Assistant Professor of Zoology, Invertebrate Zoology, Univ. of Calif. at Berkeley
Hamner, William, Ph. D., Associate Professor of Zoology, Ecology, Univ. of Calif. at Davis
Hand, Cadet, Ph. D., Professor of Zoology, Invertebrate Zoology, Univ. of Calif. at Berkeley
Lipps, Jere, Ph. D., Associate Professor of Geology, Marine Geology and Paleoecology, Univ. of Calif. at Davis
Miller, Milton A., Ph. D., Professor of Zoology, Invertebrate Zoology, Univ. of Calif. at Davis
Pressick, Mary Lou, Ph. D., Assistant Professor of Zoology, Ecology, Univ. of Calif. at Berkeley.
Smith, Ralph, Ph. D., Professor of Zoology, Invertebrate Zoology, Univ. of Calif. at Berkeley
Valentine, James, Ph. D., Professor of Geology, Marine Geology and Paleoecology, Univ. of Calif. at Davis
West, John, Ph. D., Associate Professor of Botany, Marine Botany, Univ. of Calif. at Berkeley

To obtain further information, address all inquiries directly to:
Dr. Cadet Hand, Director
Bodega Marine Laboratory
P. O. Box 247
Bodega Bay, California 94923

UNIVERSITY OF CALIFORNIA, DAVIS
Davis, California 95616

The marine sciences program on the Davis campus provides instruction and research opportunities in geological and biological oceanography. This program is offered in the Departments of Geology and Zoology and the Institute of Ecology. Each of these instructional units provides modern well-equipped laboratory, instrumental, and shop facilities, including transmission and scanning electron microscopes, an electron micro-probe, controlled environment rooms, seawater systems, etc. The Zoology Department and Institute of Ecology moved into new buildings in 1970 and the Geology Department moved into a new building in 1971.

In addition to the facilities on the Davis campus, the marine sciences program is supported by the Bodega Marine Laboratory, Bodega Bay, California.

The following degrees are offered in the basic sciences:

1. B.A., B.S., M.S., Ph.D. in Geology with specialization in marine science (Department of Geology).

2. B.A., B.S., M.A., Ph.D. in Zoology (Department of Zoology).

3. M.S., Ph.D. in Ecology with specialization in marine science (Ecology Graduate Group).

4. M.S., Ph.D. in Biochemistry (Biochemistry and Biophysics Department).

The Departments of Geology and Zoology and the Institute of Ecology offer advanced degrees with thesis research in marine geology, ecology, paleoecology or sedimentary petrology. An integrated, full-time program is offered during the regular school year by the Departments of Geology and Zoology. A special curriculum in "animal evolution in marine ecosystems" is provided for advanced undergraduates and graduates by the Geology and Zoology Departments during the spring quarter.

The following courses are offered in conjunction with the above programs:

ECOLOGY

201A	Ecological Theory	3
201B	Analysis of a Selected Ecosystem	3
201C	The Changing Biosphere	3
290	Seminar in Ecology	1

ENVIRONMENTAL STUDIES

140	Limnology	4
140L	Limnology Laboratory	3
144	Oceanography	4

GEOLOGY

105	Structural Geology	4
107	Paleobiology	5
111A	Paleobiology of Invertebrata	4
111B	Paleobiology of Protista	4
S119	Marine Geology and Paleobiology	9
126	Sedimentation	4
153	Studies in Geomorphology	3
190	Seminar in Geology	1
198	Directed Group Study	1-5
199	Special Study for Advanced Undergraduates	1-4
213	Geomorphology	3
216	Tectonics	3
S219	Research in Marine Geology and Paleobiology	6-9
257	Sedimentary Petrology: Terrigenous Rocks	4
258	Sedimentary Petrology: Carbonate Rocks	4
260	Paleontology	3
261	Paleoecoenology	3
262	Paleosystematics	3
263	Functional Morphology of Fossil Invertebrates	4
290	Seminar in Geology	1
298	Group Study	2
299	Research	1-6

ZOOLOGY

112	Invertebrate Zoology	5
114	Invertebrate Physiological Ecology	5
116	Principles of Animal Resource Management	5
125	Animal Ecology	3
125L	Field Ecology	3
142	Invertebrate Physiology	4
142L	Invertebrate Physiology Laboratory	3
147	Zoogeography	4
148	Animal Phylogeny and Evolution	5
197	Senior Colloquium in Zoology	2
199	Special Study for Advanced Undergraduates	1-5
202	Biomathematics	6
222	Mathematical Models of Ecosystems	4
223	Seminar in Fisheries Management	4
293	Seminar in Invertebrate Zoology	2
294	Seminar in Animal Ecology	3
297	Seminar in Systematic Zoology and Evolution	2
298	Group Study	1-5
299	Research	1-9

The instructional staff for the courses listed above consists of the following:

DIVISION OF ENVIRONMENTAL STUDIES

Goldman, Charles R., Ph.D., Professor

DEPARTMENT OF GEOLOGY

Bond, Gerard, Ph.D., Assistant Professor
Cowen, Richard, Ph.D., Assistant Professor
Higgins, Charles G., Ph.D., Professor
Lipps, Jere H., Ph.D., Associate Professor
Moores, Eldridge M., Ph.D., Assistant Professor
Valentine, James W., Ph.D., Professor

DEPARTMENT OF ZOOLOGY

Hamner, William M., III., Ph.D., Assistant Professor
Miller, Milton A., Ph.D., Professor
Rudd, Robert L., Ph.D., Associate Professor
Salt, George W., Ph.D., Associate Professor
Watt, Kenneth E.F., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Graduate Advisor
Division of Environmental Studies
University of California
Davis, California 95616

The Institute of Marine Resources was recently transferred from the Berkeley campus to Davis. A new temporary building has been built to house the offices and laboratories of the Marine Food Science Laboratory. The laboratory is primarily a research facility and is equipped to study the chemistry and biochemistry of marine organisms as they may be useful as sources of food.

The following degrees are offered:

1. M.S. in Food Science.

2. M.S., Ph.D. in Nutrition, Agricultural Chemistry, Biochemistry.

3. B.S. in Wildlife and Fisheries Biology.

The following courses are offered in conjunction with the above programs:

WILDLIFE AND FISHERIES BIOLOGY

130	Biology of Fish	5
110B	Principles of Fish Management	3
101	Field Studies in Wildlife and Fish Management	5
120	Functional Morphology of Fishes	4
121	Physiology of Fishes	4
122	Biological Management of Fishes	3
291	Advanced Topics in Fish Biology	2

These courses are augmented by the extensive course offerings of the Department of Zoology, above.

The instructional staff for the courses listed above consists of the following:

FOOD SCIENCE AND TECHNOLOGY

Brown, W.D., Ph.D., Professor of Marine Food Science
Olcott, H.S., Ph.D., Professor of Marine Food Science

ANIMAL PHYSIOLOGY

Brocksen, R.W., Ph.D., Lecturer

Moyle, P. B., Ph. D., Assistant Professor
Li, H. W., Ph. D., Assistant Professor

To obtain further information, address all inquiries directly to:

MARINE FOOD SCIENCES

H. S. Olcott
Institute of Marine Resources
University of California
Davis, California 95616

WILDLIFE AND FISHERIES BIOLOGY

J. M. Boda
Animal Physiology
University of California
Davis, California 95616

UNIVERSITY OF CALIFORNIA, IRVINE
School of Biological Sciences
Irvine, California 92664

The University of California, Irvine, is located approximately three miles from the Pacific Coast. All of the laboratory, library, physical resources and staff are available to students of marine biology 12 months of the year. In addition to salt water holding facilities on campus, the School of Biological Sciences has a small, seaside installation with running sea water, docking space and student laboratory which it shares with the Orange County Sea Explorers. The school has two Boston Whalers equipped with outboard motors and provisions for trawling, inshore sampling and Scuba diving. Ancillary and specialized equipment includes a fathometer, ship to shore radio, current meter, bottom sampler, plankton nets, otter trawl and seins. The school also employs a full-time marine technician.

The School of Biological Sciences offers the Ph. D. degree in biology. Degree programs are designed to accommodate the individual interests of the participating graduate students and include emphasis and training in marine ecology, marine productivity, physiology of marine animals, neurobiology of marine animals, development of marine organisms and biomedical marine biology. There have been seven Ph. D. degrees awarded in the School of Biological Sciences with emphasis in marine biology since 1968.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

169A-B	Marine Ecology	4
175	Phycology	4
176	Phyloplankton Biology	4
178	Aquatic Productibity	4
180A-B	Invertebrate Zoology	4-4

GRADUATE

231	Comparative Animal Physiology	4
231L	Comparative Animal Physiology Lab	2
264	Coelenterate Biology	4-4-4
266	Comparative Physiology	4
226	Seminar in Marine Ecology	2
228	Seminar in Phytoplankton Biology	2
229	Seminar in Community Ecology	2
200-A-B-C	Research in Population and Environmental Biology	Varies
201	Seminar in Population and Environmental Biology	2
203-A-B-C	Graduate Tutorial in Population and Environmental Biology	Varies
273	Physiological Animal Ecology	4
278	Productivity Ecology	4

The instructional staff for the courses listed above consists of the following:

MARINE BIOLOGY

Campbell, Richard D., Associate Professor
Dixon, Peter S., Professor
Hunt, George L., Assistant Professor
Josephson, Robert K., Professor
Koopowitz, Harold, Assistant Professor
Lenhoff, Howard M., Professor
Littler, Mark M., Assistant Professor
Seapy, Roger R., Assistant Professor
Stephens, Grover C., Professor

To obtain further information, address all inquiries directly to:

Dr. R. L. Pardy
Assistant Dean and Coordinator of
Graduate Programs in Marine Biology
School of Biological Sciences
University of California, Irvine
Irvine, California 92664

UNIVERSITY OF CALIFORNIA AT LOS ANGELES
Los Angeles, California 90024

While UCLA does not have a marine sciences program as an interdepartmental institution, there are a number of courses available to the student in the marine sciences. The principle research facilities are on the main campus in West Los Angeles. Access to the marine laboratory on Catalina Island is also available through a consortium with several other institutions in the greater Los Angeles area. There is a recirculating 20, 000 gallon seawater system housed in the Life Sciences building and a number of small craft available through the fisheries group within the Biology Department. Extensive research facilities in the biological and physical sciences are available on the campus. Formal basic and advanced Scuba-diving training is taught on the campus. Underwater techniques are taught through the Kinesiology Department.

The following degrees are offered: M. A. in Biology, M. A. in Geology, Ph. D. in Biology and Ph. D. in Geology. Degree requirements are determined by the department.

The following courses are offered in conjunction with the above programs:

BIOLOGY

25	The Oceans	4
101	The Biology of Algae, Lichens and Fungi	4
105	Biology of Invertebrates	4
106A-B	Marine Invertebrate Zoology	4
112	Ichthyology	4
114	Ornithology	4
115	Mammalogy	4
122	Ecology	4
124	Field Ecology	4
126	Analysis of Ecological Data	4
206	Advanced Ichthyology	4

208	Biology of Aquatic Mammals	4
255	Seminar in Invertebrate Zoology	2
258	Seminar in Ichthyology	2
261	Seminar in Aquatic Mammals	2
272	Seminar in Marine Biology	2

GRADUATE (offered at Catalina Island Lab in conjunction with the University of Southern California)

205	Marine Invertebrate Biology	4
217	Marine Ecology	4
218	Oceanology	4
224	Developmental Biology of Marine Organisms	4
240	Physiology of Marine Animals	4

ENGINEERING AND APPLIED SCIENCES

284E	Saline Water Conversion	

GEOLOGY

144	Marine Geology	4

KINESIOLOGY

280D	Underwater Kinesiology	

Instructional staff for the courses above consists of the following:

BIOLOGY

Bartholomew, George, Ph. D., Professor
Gordon, Malcolm, Ph. D., Professor
Landenberger, Donald, Ph. D., Assistant Professor
McDonald, Kent, Ph. D., Acting Assistant Professor
Morin, James, Ph. D., Assistant Professor
Muscatine, Leonard, Ph. D., Professor
O'Connor, John D., Ph. D., Assistant Professor
Odell, Daniel, Ph. D., Acting Assistant Professor
Walker, Boyd, Ph. D., Professor
Walters, Vladimir, Ph. D., Associate Professor

GEOLOGY

Lane, N. Gary, Ph. D., Professor
Hall, Clarence, Ph. D., Professor
Isaac Kaplan, Ph. D., Professor

KINESIOLOGY

Egstrom, Glen, Ph. D., Professor
Gardner, Gerald, Ph. D., Associate Professor

To obtain further information address all inquiries directly to:

Dr. Malcolm Gordon, Director
Institute of Evolutionary and Environmental Biology
University of California
Los Angeles, California 90024

UNIVERSITY OF CALIFORNIA
Riverside, California 92502

The Department of Geological Sciences at Riverside offers the following courses relevant to marine sciences: Geological Sciences, Introduction to Oceanography and Marine Geology.

UCR is a member of the consortium that operates the Catalina Marine Biological Laboratory. (see listing for the University of Southern California, detailed information as to course schedules may be obtained from the Resident Director, Santa Catalina Marine Biological Laboratory, P. O. Box 398, Avalon, California 90704.)

Full-time faculty members involved in the marine curricula in the Department of Geological Sciences, Riverside, are:

Cohen, L. H., Ph. D., Associate Professor of Geology
Cook, H. E., Ph. D., Associate Professor of Geology
Schlanger, S. O., Ph. D, Chairman and Professor of Geology

Inquiries should be directed to:

S. O. Schlander
Department of Geological Sciences
University of California
Riverside, California 92502
(714) 787-3434

UNIVERSITY OF CALIFORNIA
Santa Barbara, California 93106

Several departments offer a wide selection of marine-related courses. A new major has just been approved by the department, aquatic (marine and freshwater) biology. Also, with permission, students can arrange for an individually designed marine-oriented major. Courses with marine content are the following:

BIOLOGICAL SCIENCES

105	Biology of fishes	2
105AL	Lab in biology of fishes	2
105BL	Problems in ichthyology	2
112A	Invertebrate zoology	4
112B	The invertebrate as an experimental animal	3
112L	Problems in invertebrate zoology	3
115	Biology of arthropods-aquatic	2
115L	Lab in biology of arthropods	2
117AL	Lab in arthropod diversity	1
145A	Physics and chemistry of aquatic environments	3
145AL	Chemical and physical methods of aquatic environments	2
145B	Biology of aquatic systems	3
145BL	Methods of aquatic biology	2
145CL	Lab in aquatic biology	2
155	Conservation of aquatic resources	3
161	Systematics of fishes	2
161L	Lab in systematics of fishes	2
170	Phycology	2
170L	Lab in phycology	2
171	Developmental phycology	2
171L	Lab in development phycology	2
194I/Q/S/Z	Group studies in Phycology/Aquatic biology Protist physiology/Marine Pollution	
234	Physiology of algae	2
234L	Lab in physiology of algae	2
250	Marine phytoplankton	2
250L	Lab in marine phytoplankton	1
251	Cultivation of marine planktonic protists	1
251L	Lab in cultivation of marine planktonic protist	1
595I/Q/S/Z	Group studies in Phycology/Aquatic biology/ Protist physiology/Marine pollution	

ECONOMICS

115	Environmental economics	4

GEOGRAPHY

144	Cultural geography of the sea	4
145	Resource ecology of the marine environment	4

GEOLOGICAL SCIENCES

4	Introduction to oceanography	4
105	Marine geology	4
111	Concepts of paleontology	4
190	Advanced studies of paleontology	1-4
214	Seminars: Problems in marine science	4
235	Marine tectonics	3
250	Contemporary issues in earth and planetary history	2-6

The instructional staff for the courses listed above consists of the following:

Childress, James T., Ph. D., Assistant Professor of Zoology
Cloud, Preston, Ph. D., Professor of Biogeology
Connel, Joseph H., Ph. D., Professor of Zoology
Davenport, Demorest, Ph. D., Professor of Zoology
Deacon, Robert T., M. A., Acting Assistant Professor of Economics
Ebeling, Alfred W., Ph. D., Professor of Zoology
Holmes, Robert W., Ph. D., Associate Professor of Marine Biology
Howmiller, Richard P., Ph. D., Assistant Professor of Biology
Karig, Daniel E., Ph. D., Assistant Professor of Oceanography
MacDonald, Keith B., Ph. D., Assistant Professor of Oceanography
Neushul, Michael, Jr., Ph. D., Professor of Botany
Norris, Robert M., Ph. D., Professor of Geology
Sanders, Norman K., Ph. D., Assistant Professor of Geography
Sweeney, Beatrice M., Ph. D., Professor of Biology
Wenner, Adrian M., Ph. D., Associate Professor of Biology

The Marine Science Institute is an interdepartmental organization which seeks to promote and facilitate research in marine science. The research interests of the institute are focused largely on the local coastal area: the characteristics, resources and uses, both present and anticipated, of the near-shore marine environment and the effects of the use and development of the marine environment and the effects of the use and development of the marine environment upon the coastal zone communities. Participants in the institute include representatives from such departments as anthropology, biological sciences, economics, electrical engineering, geography, geological and political sciences.

To obtain further information, address all inquiries directly to:

Robert W. Holmes
Department of Biological Sciences
University of California, Santa Barbara
Santa Barbara, California 93106

UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Santa Cruz, California 95060

The University of California, Santa Cruz, is located 75 miles south of San Francisco on 2,000 acres overlooking Monterey Bay and the Pacific Ocean. The campus recently received a gift of 40 acres, including a beach, lagoon and headlands, which will be the site of teaching and research programs in marine sciences. Tidepools near this property are under campus control, as is Ano Nuevo Island, colonized by five species of seals and sea lions. Undergraduate courses, jointly with other UC campuses, are offered at the Bodega Marine Laboratory. Students may concentrate in marine studies on majors in either the Biology or Earth Science Board of Studies.

The Biology Board of Study offers B. A., and Ph. D. degrees, as well as the degree, Candidate in Philosophy. For the B. A. degree, UCSC requires the completion of 36 courses. For the biology major, nine biology courses including four upper-division non-laboratory courses, are required. The Ph. D. degree requires satisfactory completion of prescribed course work, a foreign language examination, a qualifying examination, a dissertation, and one quarter of teaching experience. The course work required varies depending upon the area of specialization and background of the student.

The Earth Sciences Board of Studies offers the B. S., B. A., and Ph. D. degress. For the B. S. degree, nine earth sciences courses, including a seminar course in field geology, mathematics through calculus, and four other natural science courses are required. For the B. A. less mathematics is required, as well as seven earth sciences courses.

The following courses are offered in conjunction with the above programs:

BIOLOGY

1, 1L	Introductory Biology with Laboratory
2, 2L	Introductory Biology with Laboratory
70	Aquatic Productivity
101	Nonseed Plants with Laboratory
104L	General Microbiology with Laboratory
121, 121L	Invertebrate Zoology with Laboratory
122	Neritic Ecology
125	Marine Invertebrate Embryology
128, 128L	Comparative Vertebrate Morphology with Laboratory
129ABC	Problems in Marine Biology
141	Genetics
144L	Ecology Laboratory
145	Animal Ecology
146, 146L	Development with Laboratory
152	Ethology
153	Field Studies in Animal Behavior
155, 155L	Biology of Marine Mammals with Laboratory
161, 161L	Plant Physiology with Laboratory
162, 162L	Cell Physiology with Laboratory
181	Biochemistry
182	Biochemistry of Macromolecules
190A	Proseminar: Intertidal Organisms
204	Topics in Cryptogram Biology
223	Topics in Invertebrate Morphology
229	Topics in Marine Vertebrates

CHEMISTRY

1C	Introduction to Reaction Equilibria and Rates
3	Equilibrium, Rate and Structure
7	Quantitative Chemistry Laboratory
40	Introduction to Organic Chemistry
41	Introduction to Organic Chemistry
42	Introduction to Organic Chemistry
101	Thermodynamics
143	Biochemistry
161	Physical Chemistry
162	Physical Chemistry

PHYSICS

5A, 5B	Introduction to Physics
H5A, H5B	Introduction to Physics

MATHEMATICS

3A	Basic Mathematics (Algebra)
3B	Basic Mathematics (Calculus)
5	Elementary Basic Statistics
11A	Calculus
11B	Calculus

EARTH SCIENCES

1	Geologic Principles
2	Geologic Time
6A	The Dynamics of Landscape Formation
6B	Global Tectonics
17	Oceanography
20	The Fossil Record
120	Paleoecology
140	Environmental Geology
160	Stratigraphy - Sedimentation
170	X-ray Technique for Geologists
180	Marine Geology
260	Marine Sedimentation
268	Sedimentary Petrology
290A	Continental Margins
290B	Sedimentary Basin Analysis
290C	Paleomagnetism

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Beevers, Harry, Ph. D., Professor
Blinks, Lawrence, Ph. D., Professor
Daniel, Charles, Ph. D., Associate Professor
Davern, Cedric, Ph. D., Professor
Doyle, William, Ph. D., Professor
Hinegardner, Ralph, Ph. D., Associate Professor
Langenheim, Jean, Ph. D., Associate Professor
LeBoeuf, Burney, Ph. D., Associate Professor
Moldenke, Andrew, Ph. D., Assistant Professor
Newberry, Todd, Ph. D., Associate Professor
Norris, Kenneth., Ph. D., Professor
Pearse, John, Ph. D., Assistant Professor
Rocha, Victor, Ph. D., Assistant Professor
Silver, Mary, Ph. D., Assistant Professor
Terzaghi, Eric, Ph. D., Assistant Professor
Wang, Howard, Ph. D., Assistant Professor

EARTH SCIENCES

Coe, Robert., Ph. D., Assistant Professor
Garrison, Robert., Ph. D., Associate Professor
Griggs, Gary, Ph. D., Assistant Professor
Laporte, Leo, Ph. D., Professor
Moore, J. Casey, Ph. D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Kenneth S. Norris, Director
Coastal Marine Laboratory
University of California, Santa Cruz
Santa Cruz, California 95060

SCRIPPS INSTITUTION OF OCEANOGRAPHY
UNIVERSITY OF CALIFORNIA, SAN DIEGO
La Jolla, California 92037

The Scripps Institution of Oceanography has been a unit of the University of California since 1912. It is now part of the University of California San Diego campus, with nine buildings clustered on the ocean shore north of the center of La Jolla. The SIO Library contains more than 95,000 volumes, 43,000 reports and reprints, 3,000 serials and 45,000 maps and charts.

Special facilities include: Radio station WWD, operated by the U.S. National Marine Fisheries Service; the Scripps pier, 1,000 feet long, housing apparatus for a number of serial oceanographic observations and used as a landing place for skiffs; the salt water system providing clean seawater to the aquarium and biological laboratories; an underwater area for research and collecting offshore from the institution; deep-sea sediment cores from several thousand widely scattered localities and original echograms and underway geophysical data along several hundred thousand miles of ships' tracks in the oceans of the world; an oceanographic data archive of some half a million bathythermograph observations; electron microprobe laboratories, six mass spectrographs, several thousand samples of sea water from the world oceans; an electron microscope laboratory; the Scripps fish collection of more than 750,000 specimens of some 2,500 species of marine fish, and oceanic samples of plankton. Scripps scientists have access to the university's computer center and have a shipboard computer group with computers on several of the larger ships in the fleet as well as another on the SIO campus.

The institution operates seven ships specially fitted for oceanographic research: Alexander Agassiz, Alpha Helix, Oconostota, E. B. Scripps, Thomas Washington, Melville, ST-908, and FLIP (Floating Instrument Platform).

The Graduate Department of the institution offers graduate instruction leading to M.S. and Ph.D. degrees in oceanography, marine biology and earth sciences. Emphasis is on the Ph.D. program although the M.S. is awarded if circumstances warrant, either on a comprehensive examination plan or on a thesis plan. No undergraduate major is offered in the department, although most courses are open to enrollment for qualified undergraduate students, with consent of the instructor. Graduate students normally concentrate on one of several curricular programs within the department, including: biological oceanography, marine biology, marine chemistry, geological sciences, geophysics, physical oceanography, and applied ocean sciences. The last is carried out as a joint program with the Department of Applied Mechanics and Engineering Sciences and the Department of Applied Physics and Information Science. The interdisciplinary nature of research in marine sciences is emphasized, and students are encouraged to take courses in several programs and departments and to select research problems of an interdisciplinary nature. The department has no formal language requirements, although some curricular groups require one or two languages or demonstration of ability to use certain foreign languages pertinent to a student's research.

Candidates for admission should have a bachelor's or master's degree in one of the physical, biological or earth sciences; in some cases, a degree in mathematics or engineering science is accepted. The student's preparation should include a solid background in mathematics, physics, chemistry, biology, geology and prior study of at least one foreign language. All students are normally required to take a departmental examination, and the student is expected to demonstrate a comprehension of required subject material and of the pertinent interactions of physical, chemical, biological or geological factors. After the student has passed the departmental examination and has completed an appropriate period of additional study, the department recommends the appointment of a Doctoral Committee. This committee de-

termines the student's qualification for independent research by means of a qualifying examination and supervises the student's performance and reporting of research. A requirement for the Ph. D. degree is the submission of a dissertation and a final examination at which time the thesis is publicly defended.

The following courses are offered in conjunction with the above programs:

GRADUATE

207A-207B	Problems in General and Physical Oceanography	2, 2
208	Oceanography Field Course	2-4
209	Special Topics	1-4
210A	Physical Oceanography	3
210B	Physical Oceanography	3
211A-211B	Ocean Waves	3, 3
212A-212B	Dynamical Oceanography	3, 3
213A-213B	Radiative Transfer in the Sea	2-3
214	Introduction to Fluid Mechanics	3
216A-216B	Physics of Sediment Transport	3, 3
219	Special Topics in Physical Oceanography	1-4
222A-222B	Hydrodynamics	3, 3
223	Geophysical Measurements	3
225	Tides and Rotation of the Earth	3
226A-226B	Internal Constitution of the Earth	3, 3
227A-227B	Seismology	3, 3
229	Geomagnetism	3
230	Introduction to Inverse Theory	3
231A-231B	Seismological Methods	3, 3
232	Interpretation of Seismograms	1
240	Marine Geology	3
241	Continental Margin Sediments	3
242A-242B	Marine Micropaleontology	3, 3
243	Marine Stratigraphy	3
244	Marine Geophysical Exploration	3
245	Sedimentary Petrology	3
246A	Problems in Paleooceanography	2
246B	Biogenous Deep-Sea Sediments	3
247	Tectonics	3
248A-B-C	Seminar in Marine Geology	3, 3, 3
249	Special Topics in Marine Geology	1-4
250	Geochemistry	3
251	Thermodynamics of Natural Processes	3
252A	Nuclear Geochemistry	3
252B	Nuclear Geophysics	3
253A	Igneous and Metamorphic Petrology	3
253B	Mineralogic and Petrographic Laboratory	2
254	Advanced Igneous Petrology	3
255	Crustal Evolution	3
256A	Field Geology	4
256B	Earth Sciences Spring Field Trip	1
256C	Earth Sciences Summer Field Course	6
257	Seminar in Petrology	3
258	Seminar in Geology	3, 3, 3
259	Seminar in Geochemistry	3, 3, 3
260	Marine Chemistry	3
261	Physical Chemistry of Seawater	3
262	Major Sedimentary Cycle	3
263	Major Chemical Cycles in the Sea	3
264	Solids in Nature	3
265	Chemistry of Natural Products	3
266	Geochemistry of Organic Compounds	3
267	Management of the Marine Environment	3
268	Seminar in Marine Chemistry	1
269	Special Topics in Marine Chemistry	1-4
270	Biological Oceanography: Processes and Events	3
270L	Laboratory in Biological Oceanography	
272	Oceanic Zoogeography	3
273	Introduction to Animal Behavior	3
275A-275B	Marine Ecology	3, 3
275C	Topics in Community Ecology	3
276A-276B	Applied Statistics	3, 3
277	Deep-Sea Biology	2
278	Problems in Biological Oceanography	2, 2, 2
279	Special Topics in Biological Oceanography	1-4
280	Marine Communities and Environments	3
280L	Laboratory in Marine Organisms	2
281	Environmental Physiology and Biochemistry of Marine Organisms	3
282	Physiology of Marine Vertebrates	3
282L	Laboratory in Physiology	4
283	Isotope Trace Techniques and Related Topics in Physiology	3
284	Cell Physiology of Marine Organisms	4
285	Marine and Comparative Biochemistry	3
285L	Methods in the Comparative Biochemistry of Marine Organisms	4
286	Cellular Structure and Biochemical Function	3
287	Marine Microbiology	2
288A-288B	Ecology of Shore Microbes	3, 3
289	Marine Plants	3
291	Physiology of Marine Algae	3
292	Developmental Biology of Marine Organisms	2
292A	Advanced Invertebrate Zoology	4
293B	Advanced Invertebrate Zoology	4
294A	Biology of Fishes	4
294B	Seminar in Advanced Ichthyology	2, 2
296	Special Topics in Marine Biology	1-4
297	Marine Biology Seminar	1
298	Special Studies in Marine Sciences	1-2
299	Research	1-12

The instructional staff for the courses listed above consists of the following:

Ahlstrom, E. H., Ph. D., Adjunct Professor of Oceanography
Anderson, V. C., Ph. D., Professor of Applied Physics
Arrhenius, G., D. Sc., Professor of Oceanography
Arthur, R. S., Ph. D., Professor of Oceanography
Atwater, T. M., Ph. D., Assistant Professor of Geophysics
Backus, G. E., Ph. D., Professor of Geophysics
Bada, J. L., Ph. D., Assistant Professor of Oceanography
Beers, J. R., Ph. D., Lecturer in Oceanography
Benson, A. A., Ph. D., Professor of Biology
Berger, J., Ph. D., Lecturer in Geophysics
Berger, W. H., Ph. D., Assistant Professor of Oceanography
Brinton, E., Ph. D., Lecturer in Oceanography
Brune, J. N., Ph. D., Professor of Geophysics
Bullard, E. C., F. R. S., Sc. D., Professor of Geophysics
Bullock, T. H., Ph. D., Professor of Neurophysiology
Carlucci, A. F., Ph. D., Lecturer in Marine Biology
Cox, C. S., Ph. D., Professor of Oceanography
Craig, H., Ph. D., Professor of Geochemistry and Oceanography
Curray, J. R., Ph. D., Chairman and Professor of Oceanography
Davis, R. E., Ph. D., Associate Professor of Oceanography
Dayton, P. K., Ph. D., Assistant Professor of Oceanography
Duntley, S. Q., Ph. D., Professor of Physics
Engel, A. E. J., Ph. D., Professor of Geology
Enns, T., Ph. D., Lecturer in Marine Biology
Enright, J. T., Ph. D., Associate Professor of Oceanography
Epel, D., Ph. D., Associate Professor of Biology
Fager, E. W., Ph. D., D. Phil., Professor of Marine Ecology
Faulkner, D. J., Ph. D., Assistant Professor of Oceanography

Fleminger, A., Ph. D., Lecturer in Marine Biology
Foster, T. D., Ph. D., Lecturer in Oceanography
Gibson, C. H., Ph. D., Associate Professor of Engineering Physics
Gieskes, J. M. T., Ph. D., Assistant Professor of Oceanography
Gilbert, J. F., Ph. D., Professor of Geophysics
Goldberg, E. D., Ph. D., Professor of Chemistry
Hammel, H. T., Ph. D., Professor of Physiology
Haubrich, R. A., Ph. D., Professor of Geophysics
Hawkins, J. W., Ph. D., Associate Professor of Geology
Haxo, F. T., Ph. D., Professor of Biology
Hendershott, M., Ph. D., Assistant Professor of Oceanography
Hessler, R. R., Ph. D., Associate Professor of Oceanography
Holland, N. D., Ph. D., Associate Professor of Marine Biology
Holm-Hansen, O., Ph. D., Lecturer in Marine Biology
Inman, D. L., Ph. D., Professor of Oceanography
Isaacs, J. D., B. S., Professor of Oceanography
Kastner, M., Ph. D., Assistant Professor of Geology
Keeling, C. D., Ph. D., Professor of Oceanography
Lal, D., Ph. D., Professor of Nuclear Geophysics
Lasker, R., Ph. D., Associate Adjunct Professor of Marine Biology
Lewin, R. A., Ph. D., Professor of Biology
McGowan, J. A., Ph. D., Professor of Oceanography
Menard, H. W., Ph. D., Professor of Geology
Molnar, P. H., Ph. D., Lecturer in Geophysics
Mudie, J. D., Ph. D., Assistant Professor of Geophysics
Mullin, M. M., Ph. D., Associate Professor of Oceanography
Munk, W. H., Ph. D., Professor of Geophysics
Newman, W. A., Ph. D., Associate Professor of Oceanography
Nierenberg, W. A., Ph. D., Professor of Physics, Dean and Director, Scripps Institution of Oceanography, and Vice Chancellor-Marine Sciences, University of California, San Diego
Parker, R. L., Ph. D., Associate Professor of Geophysics
Peterson, M. N. A., Ph. D., Associate Professor of Oceanography
Phleger, F. B, Ph. D., Professor of Oceanography
Raitt, R. W., Ph. D., Professor of Geophysics
Reid, J. L., M. S., Lecturer in Oceanography
Riedel, W. R., M. S., Lecturer in Oceanography
Rosenblatt, R. H., Ph. D., Professor of Marine Biology and Vice Chairman
Scholander, P. F., M. D., Ph. D., Professor of Physiology
Shor, G. G., Ph. D., Professor of Marine Geophysics
Somero, G. N., Ph. D., Assistant Professor of Biology
Spiess, F. N., Ph. D., Professor of Oceanography
Vacquier, V., M. A., Professor of Geophysics
Van Atta, C. W., Ph. D., Associate Professor of Engineering Physics and Oceanography
Volcani, B. A., Ph. D., Professor of Microbiology
Winterer, E. L., Ph. D., Professor of Geology
Wooster, W. S., Ph. D., Professor of Oceanography

To obtain further information, address all inquiries directly to:

Dr. Joseph R. Curray
Chairman, Graduate Department
Scripps Institution of Oceanography
P. O. Box 109
La Jolla, California 92037

CALIFORNIA MARITIME ACADEMY
Vallejo, California 94590

The California Maritime Academy is located at Vallejo on Carquinez Straits, about 40 miles from San Francisco. The campus is a 67-acre site containing a residence hall, classroom buildings, cafeteria, gymnasium and pool, library, administration building, and laboratories--in addition to a deepwater pier and boat basin.

The federal Maritime Administration has provided the Academy with a 16-knot training ship of 10,000 dead-weight tons for the purpose of conducting the annual three-month training period. The training ship, Golden Bear, is operated by the midshipmen under the supervision of the Academy's licensed officer/instructors during this cruise to foreign waters.

A number of smaller vessels are also operated by the Academy, including a 75-foot yawl, a 35-foot sloop, two diesel boats of 65 feet, and a number of small craft.

The academy offers two curricula, one leading to the Bachelor of Science in Marine Engineering, and the other leading to the Bachelor of Science in Nautical Science. Upon completion of the three-year, year-round program each graduate, in addition to his B. S. degree, receives a Coast Guard license qualifying him to serve as a third assistant engineer or third mate in the merchant marine, and a commission as Ensign in the United States Naval Reserve if fully qualified.

The following courses are offered by the professional departments toward the completion of the degrees listed above:

DEPARTMENT OF MARINE ENGINEERING

E-109	Engineering Graphics	1
E-111	Steam Engineering I	3
E-112	Steam Engineering II	2
E-113	Maritime Economic History	1
E-115	Boats	1
E-116	Boats	3/4
E-118	Machine Shop Lab	1½
E-120	Marine Machinery Lab	3
E-208	Machine Shop Theory	1
E-201	Steam Engineering III	2
E-202	Steam Engineering IV	2
E-203	D-C Electrical Engineering	3
E-204	A-C Electrical Engineering	3
E-212	Thermodynamics	3
E-214	Electronics	2
E-216	D-C Electrical Laboratory	1½
E-217	Machine Shop Lab	1½
E-218	Marine Machinery Lab	1½
E-220	Arc and Gas Welding	1½
E-221	Refrigeration and Air Conditioning	2
E-223	Marine Machinery Lab	3
E-301	Steam Engineering V	5
E-302	Steam Engineering VI	3
E-303	Diesel Engineering I	3
E-304	Diesel Engineering II	3
E-305	Engineering Materials	3
E-306	Ship Construction and Damage Control	3
E-307	Automation Principles	2
E-310	Nuclear Power	2
E-312	Engineering Administration	1
E-314	Labor Relations	1
E-315	Diesel Laboratory	1½
E-316	Advanced Diesel Laboratory	1½
E-317	A-C Electrical Laboratory	1½
E-318	License Seminar	2
E-319	Marine Machinery Lab	1½
E-320	Marine Machinery Lab	1½

DEPARTMENT OF NAUTICAL SCIENCE

D-108	Navigation	3
D-110	Engineering Graphics	1
D-111	Seamanship	3
D-112	Rules of the Road	2
D-115	Marlinspike Seamanship	1
D-116	Marlinspike Seamanship	1

D-117	Boats	1
D-118	Boats	1
D-125	Ship's Operations	3
D-126	Ship's Operations	3
D-201	Navigation	4
D-202	Navigation	3
D-203	Spherical Trigonometry	3
D-207	Ship Construction	3
D-208	Maritime Economics	2
D-210	Ship Stability	3
D-212	Rules of the Road	2
D-215	Applied Seamanship	1
D-216	Applied Seamanship	1
D-222	Instruments and Navigational Aids	1
D-223	Communications	1
D-225	Ship's Operations	3
D-226	Ship's Operations	3
G-300	Introductory Oceanography	2
G-301	Introductory Oceanography	2
D-301	Navigation	3
D-302	Navigation	3
D-303	Meteorology	3
D-304	Maritime Law	3
D-305	Radar	1
D-306	Marine Rules and Regulations	3
D-308	License Seminar	2
D-309	Cargo I	3
D-310	Cargo II	3
D-311	Seamanship	3
D-312	Rules of the Road	3
D-315	Applied Seamanship	1
D-323	Communications	1
D-325	Ship's Operations	2
D-326	Ship's Operations	1
D-330	Merchant Ship Operations	4

Approximate number of degree recipients each year:

Marine Engineering	30
Nautical Science	30

The instructional staff for the courses listed above consists of the following:

Department of Marine Engineering

Arnett, Dennis, B. S. (License: First Assistant Engineer), Instructor
Behrn, Arthur S., B. S. (License: Chief Engineer) Senior Instructor
Beland, Thomas, B. A. (License: First Assistant Engineer), Instructor
Bruhn, Otto J., B. S., B. A. (License: Chief Engineer), Chairman of Department
LaBombard, Frank L. (License: First Assistant Engineer), Instructor
Rogers, Robert L., M. S. (License: Second Assistant Engineer), Instructor.
Thor, Howard A., Ph. D. (License: Chief Engineer), Instructor

Department of Nautical Science

Aguilar, William H., B. S. (License: Master Mariner), Chairman of Department
Bourke, Calvin, B. S. (License: Master Mariner), Instructor
Craig, Robert, B. S. (License: Second Mate), Instructor
Hayler, William B., M. A. (License: Master Mariner), Senior Instructor
Keever, John, B. S. (License: Third Mate), Instructor
Newton, Fred B., B. S. (License: Master Mariner), Senior Instructor
Wood, Philo, B. A. (License: Master Mariner), Instructor

To obtain further information, address all inquiries directly to:

Academic Dean
California Maritime Academy
Vallejo, California 94590

CALIFORNIA POLYTECHNIC STATE UNIVERSITY
San Luis Obispo, California 93401

A recently completed Science North building houses a recirculating seawater system with water tables in a marine teaching laboratory, student research laboratory and faculty office-preparation room complex. A boat and gear storage building is adjacent, housing a seawater storage tank, a 16-foot outboard dory and trailer, overhead crane, net drying racks and gear storage lockers. Four 12-foot skiffs are available as well for use on Morro Bay and Port San Luis. A 24-foot inboard cruiser owned by two faculty members and equipped with hydrographic and biological gear is currently being used in research and teaching. Fishing boats at Morro Bay and Port San Luis are available for charter for open-water work.

A variety of well equipped laboratories are available in the agricultural engineering area for class and student use for the mariculture engineering program. A wide range of commercial marine industries are in the proximity. Facilities are available at the campus computer center for analysis of data.

The following degrees are offered:

1. B. S. in Biological Sciences, with a major concentration in marine biology.
2. M. S. in Biological Sciences.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BIOLOGICAL SCIENCES

Bio 328	Marine Biology	4
Bio 437	Marine Resources	4
Bact 435	Marine Microbiology	4
Bot 337	Algology	4
Cons 422	Freshwater Fisheries	3
Zoo 322	Biology of Fishes	4
Zoo 336	Invertebrate Zoology	4
Zoo 432	Comparative Animal Physiology	4

DEPARTMENT OF PHYSICS

Geo 321	Marine Geology	4

DEPARTMENT OF AGRICULTURAL ENGINEERING

MarE 222	Survey of Mariculture Engineering	4
MarE 223	Mariculture Engineering Laboratory	3
MarE 233	Marine Surveying and Topography	4

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCES

Booth, James, Ph. D., Assistant Professor of Biological Sciences: Marine Microbiology
Clogston, Fred L., Ph. D., Professor of Biological Sciences: Marine Biology
Fierstine, Harry L., Ph. D., Associate Professor of Biological Sciences: Biology of Fishes
Krejsa, Richard J., Ph. D., Assistant Professor of Biological Sciences: Biology of Fishes
Montgomery, David H., M. S., Associate Professor of Biological Sciences: Invertebrate Zoology
Richards, Thomas L., Ph. D., Assistant Professor of Biological Sciences: Marine Resources

Sparling, Shirley R., Ph. D., Associate Professor of Biological Sciences: Algology

PHYSICAL SCIENCES

Balthaser, Lawrence H., Ph. D., Assistant Professor of Physics: Marine Geology
Chipping, David, Ph. D., Assistant Professor of Physics: Marine Geology

MARICULTURAL ENGINEERING

Carnegie, Edgar J., M. Eng., Associate Professor of Agricultural Engineering
Grinnell, Robin R., M.S., Assistant Professor of Agricultural Engineering
Lamouria, Lloyd H., M.S., Professor and Head of Agricultural Engineering
Strohman, Rollin D., Ph. D., Assistant Professor of Agricultural Engineering

To obtain further information, address all inquiries directly to:

Department Head
Biological Sciences Department
School of Science and Mathematics
California Polytechnic State University
San Luis Obispo, California 93401

CALIFORNIA STATE UNIVERSITY, FULLERTON
Fullerton, California 92634

California State University, Fullerton is one of California's 19 publicly supported state universities and colleges and currently has an enrollment of close to 18,000. Located on 235 acres in East Fullerton, Orange County, California, the university is approximately 20 miles from the sea. The Department of Biological Science offers a program leading to a Bachelor of Arts degree for students preparing to enter graduate and professional schools, for those preparing to teach and for those preparing for careers in industry and government service. An emphasis in marine sciences is available in this undergraduate program in the Department of Biological Science. Additionally, a marine emphasis is available in the undergraduate degree program of the Department of Earth Science.

Principal research facilities are located within the Department of Biological Science. These facilities include several research laboratories equipped with such items as: 25-gallon refrigerated aquaria, dissolved oxygen meters with recorders, environmental growth chambers, research microscopes, photographic equipment, spectrophotometers, pH meters, balances, etc. Additionally, portable field equipment including bathythermographs, martex temperature, salinity and depth recorders, nansen bottles with reversing thermometers, Kahl marine photometers and plankton nets are available for use. The university owns two 16-foot Boston Whalers equipped with fittings for marine work.

The university is one of the founding members of the Southern California Ocean Studies Consortium which operates out of Long Beach Harbor, approximately 30 miles from the campus. The consortium owns and operates a 52-foot research vessel, the Nautilus, which is equipped for marine work. Currently plans are being formed for the construction of a marine laboratory in Long Beach Harobr which will add another dimension to the educational and research operations of the university.

Graduate degrees offered include an M.A. in Biological Science, specializing in marine biology. Requirements are 30 units of which at least 15 must be at the 500 (graduate) level and include independent research, thesis research and one departmental seminar (six units must be outside the principal area); a thesis, a published paper or a paper accepted for publication that is acceptable to the adviser and committee, and a final oral examination on the student's research. There were ten recipients of this degree during 1971-72.

The following courses are offered in conjunction with the above program:

UNDERGRADUATE

BSC 318	Marine Biology	4
BSC 417	General Oceanography	3
BSC 418	Biological Oceanography	4
BSC 419	Marine Ecology	4
BSC 420	Biology of Marine Plankton	4
BSC 446	Phycology	4
BSC 461	Invertebrate Zoology	4
BSC 475	Ichthyology	4
ES 110	Introduction to Physical Oceanography	3
ES 330	Hydro-Meteorology and Oceanography	4
ES 430	Advanced Studies in Hydro-Meteorology and Oceanography	2

GRADUATE

BSC 518	Seminar in Marine Science	3
BSC 598	Thesis Research	1-3
BSC 599	Independent Graduate Research	1-3

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCE

Adams, Phillip, Ph. D., Professor
Bright, Donald B., Ph. D., Professor, Chairman of the Department and Chairman of the Board of Governors, Southern California Ocean Studies Consortium
Horn, Michael H., Ph. D., Assistant Professor
Lambert, Charles, Ph. D., Assistant Professor
Murray, Steven N., Ph. D., Assistant Professor

EARTH SCIENCE

Cooper, John, Ph. D., Assistant Professor
Maloney, Neil, Ph. D., Associate Professor and Chairman of the Department

CHEMISTRY

Willis, William Van, Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Donald B. Bright, Chairman
Department of Biological Science
California State University, Fullerton
Fullerton, California 92634
(714) 870-3614

CALIFORNIA STATE UNIVERSITY, HUMBOLDT
Arcata, California 95521

The marine science programs at California State University, Humboldt, offer instructional and research op-

portunities in marine fisheries, oceanography and various aspects of marine biology. The proximity of the school and the CSUH Marine Laboratory to a wide variety of marine environments offers the students ample field trip opportunity both for research and classroom work. The laboratory at Trinidad, 15 minutes from the main campus, includes a large teaching classroom and a large research laboratory. A modern seawater system and various types of aquaria and trays serve the needs of the staff and students. Vessels are chartered to support the marine science program. Present on-campus facilities include saltwater aquaria, a water chemistry laboratory, ichthyology laboratories, and zoology and botany classrooms and laboratories. In addition, a data processing center is available for student use. Equipment, technical guidance and financial aid are provided graduate students and some seniors through programs on marine sport fisheries conducted by the California Cooperative Fisheries Unit.

The college offers the following degrees through the schools indicated:

SCHOOL OF NATURAL RESOURCES

DEPARTMENT OF OCEANOGRAPHY

Bachelor of Science in Oceanography. Requirements: general education (required and elective courses to insure cultural breadth in the humanities, social sciences and english and speech); lower division requirements (nine specified courses); upper division requirements (10 specified courses); 15 units of approved science courses; at least one year of foreign language is strongly recommended (russian, german or french), and free electives to bring total number of units for the B. S. degree to 192 quarter units.

SCHOOL OF SCIENCE

DEPARTMENT OF BIOLOGY

A. B. in Biology. Requirements: general education (requirements as listed in the catalogue to insure breadth in the humanities, social sciences, english and speech); lower division requirements (five specified courses); upper division requirements (three specified courses plus option).

Master of Arts in Biology. Requirements: bachelor's degree with a major in biology, botany, zoology or related subject area approved by the Department of Biology; overall undergraduate grade point average of 2.5 or a grade point average of 3.0 for the last 90 quarter units of credit; completion of 45 upper division or graduate units in biology or supporting courses approved by the graduate committee, including a minimum of 18 units of graduate courses; a preliminary examination by the graduate committee to be taken prior to registration for the last 30 units, and completion of a total of not less than eight or more than 10 units of 290 and 299 and a thesis approved by the graduate committee.

A. B. degree in Botany. Requirements: general education (to insure breadth in the humanities, social sciences, english and speech); lower division requirements (seven specified courses); upper division requirements (12 specified courses, plus electives).

A. B. degree in Zoology. Requirements: general education (to insure breadth in the humanities, social sciences, english and speech); lower division requirements (six specified courses); upper division requirements (nine specified courses).

The following courses are offered in conjunction with the above programs:

OCEANOGRAPHY

UNDERGRADUATE

100	General Oceanography	5
101	Biological Oceanography	4
102	Physical Oceanography	4
103	Chemical Oceanography	4
105	Marine Field Techniques	3
106	Geological Oceanography	4
112	Introduction to Marine Hydrodynamics	3
115	Celestial Navigation	3
116	Marine Sedimentation	5
121	Zooplankton Ecology	4
125	Field Problems	1-3
126	Beach and Nearshore Processes	3
131	Marine Radioecology	3
180	Undergraduate Seminar	1
181	Seminar in Biological Oceanography	1
182	Seminar in Physical Oceanography	1
183	Seminar in Chemical Oceanography	1
184	Seminar in Geological Oceanography	1
190	Field Cruise	3
199	Directed Study	1-3

GRADUATE

211	Dynamics of Marine Primary Productivity	3
260	Geology and Dynamics of Estuaries	4
261	Ecology of Estuarine Organisms	3

BIOLOGY, BOTANY AND ZOOLOGY

UNDERGRADUATE

Biol 141	Marine Biology	4
Biol 142	Intertidal Ecology	4
Bot 141	Phytoplankton Physiology and Ecology	3
Bot 145	Marine Phycology	4
Zool 112	Invertebrate Zoology	4
Zool 113	Invertebrate Zoology	4
Zool 143	Comparative Physiology	4

GRADUATE

Biol 200	Selected Topics in Biology	1-3
Bot 200	Selected Topics in Botany	1-3
Zool 200	Selected Topics in Zoology	1-4
Zool 242	Benthic Ecology	3
Zool 244	Invertebrate Embryology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF OCEANOGRAPHY

Crandell, George F., Ph.D., Associate Professor and Director of Marine Laboratory
Gast, James A., Ph. D., Professor
Hodgson, Robert T., Ph.D., Assistant Professor
Pequegnat, John, M.S., Assistant Professor
Thompson, Robert W., Ph. D., Associate Professor and Program Leader for Oceanography

DEPARTMENT OF BIOLOGY

Allen, William, Ph. D., Associate Professor of Zoology
Boyd, Milton, Ph. D., Lecturer in Biology
Brusca, Gary, Ph. D., Associate Professor of Zoology
DeMartini, John, Ph. D., Professor of Zoology
Houck, Warren, Ph. D., Professor of Zoology
Rasmussen, Robert, Ph. D., Associate Professor of Botany
Yarnall, John, Ph. D., Assistant Professor of Zoology

To obtain further information, address all inquiries directly to:

Robert W. Thompson
Program Leader, Oceanography
California State University, Humboldt
Arcata, California 95521

SCHOOL OF NATURAL RESOURCES

Bachelor of Science in Fisheries. Requirements: general education (to insure breadth in the humanities, social sciences, english and speech); lower division requirements (nine specified courses); upper division requirements (eight specified courses).

Master of Science in Fisheries. Requirements: appropriate undergraduate degree, three specified courses, and required thesis, plus approved graduate courses.

The following courses are offered in conjunction with the above programs:

SCHOOL OF NATURAL RESOURCES/FISHERIES

UNDERGRADUATE

100	Introduction to Fishery Biology	3
102	Field Course in Fishery Biology	3
110	Ichthyology (classification)	4
111A	Ichthyology (Anatomy & Physiology)	3
111B	Ichthyology (Anatomy & Physiology)	3
113	Topics in Fish Taxonomy	2
120A	Physical Limnology	3
120B	Biological Limnology	3
126	Field Trip	1
130	Ecology Freshwater Fishes	4
135	Ecology of Marine Fishes	4
143	Problems in Water Pollution Biology	3
150	Introductory Fish Population Dynamics	3
160	Principles of Fishery Management	3
170	Fish Culture and Breeding	3
175	Commercial Fisheries	3
180	Techniques in Fishery Biology	3
184	Fisheries Instrumentation, Gear and Methods	2
195	Field Problems in Fisheries	1-4
198	Senior Fisheries Seminar	1

GRADUATE

240	Early Life History of Fishes	3
245	Economically Important Invertebrates	3
250	Advanced Fish Population Dynamics	3
260	Advanced Principles of Fisheries Management	3
290	Thesis	1-4
295	Research Problems in Fisheries	1-4
298	Graduate Fisheries Seminar	1

The instructional staff for the courses listed above consists of the following:

Allen, George H., Ph. D., Professor and Program Leader of Fisheries
Barnhart, Roger A., Ph. D., Adjunct Associate Professor and Unit Leader, California Cooperative Fishery Unit
Craigie, David E., Ph. D., Associate Professor of Natural Resources
DeWitt, John, Jr., Ph. D., Professor of Fisheries
Hassler, Thomas J., Ph. D., Adjunct Assistant Professor and Assistant Unit Leader, California Cooperative Fishery Unit
Ridenhour, Richard L., Ph. D., Professor of Fisheries
Roelofs, Terry D., Ph. D., Assistant Professor of Fisheries
VanKirk, Robert R., Ph. D., Assistant Professor of Natural Resources
Welsh, James P., Ph. D., Associate Professor of Fisheries

To obtain further information, address all inquiries directly to:

Dr. George H. Allen
Program Leader, Fisheries
California State University, Humboldt
Arcata, California 95521

CALIFORNIA STATE UNIVERSITY, SAN FRANCISCO
San Francisco, California 94132

Classroom and laboratory facilities are available at the main campus in San Francisco for studies in invertebrate zoology, marine botany, marine ecology, and marine microbiology. There are also facilities for graduate studies in ecology, functional morphology, systematics, physiology and ethology. A new eight-story Biological Science Building was completed in 1972 and provides graduate research laboratories, cold rooms, water tables and tanks, and recirculating sea water. The university enjoys a close working relationship with the California Fish and Game Department and the nearby California Academy of Sciences where qualified students may take advantage of the valuable library and the large collection of fishes, invertebrates, and other materials for studies in systematics and morphology. The university, in cooperation with four other state universities, operates Moss Landing Marine Laboratory as a sea-side campus extension.

M. A. in Biology with a concentration in marine biology is offered through the Department of Marine Biology. Each student is required to complete a total of 30 semester units, selected with the approval of a marine biology advisor. Courses are to consist of upper division and graduate level courses. At least one course must be taken at an approved marine station. Of graduate courses, at least two must be seminar courses. A minimum of three (maximum of six) units of research courses is required. A thesis is required (an oral or written examination may be substitited in exceptional cases) for which a student may take a maximum of six thesis research units. An oral presentation of thesis research is also required.

The following courses are offered in conjunction with the above program:

UNDERGRADUATE

Bio	486	Marine Zoogeography	2
Bio	502	Algology	4
Bio	555	Marine Invertebrate Zoology	4
Bio	556	Natural History of the Marine Invertebrates	4
Bio	560	Marine Invertebrate Physiology	4
Bio	571	Introductory Ichthyology	4
Bio	575	Introductory Fishery Biology	3
Bio	582	Biological Oceanography	3
Bio	585	Marine Ecology	4
Bio	591	Marine Science Diver Training	2

GRADUATE

Bio	700	Biological Literature	1
Bio	752	Marine Microbiology	5
Bio	786	Advanced Morphology and Ultrastructure of Marine Invertebrates	4
Bio	790	Systematic Ichthyology	4
Bio	793	Plankton	3
Bio	797	Growth and Development of Marine Algae	3
Bio	820	Ecology of Estuaries and Lagoons	3
Bio	883	Seminar: Marine Biology	1
Bio	893	Advances in Marine Biology	2
Bio	897	Research	1-3
Bio	898	Research for Master's Thesis	1-4

DEPARTMENT OF GEOLOGY

Geo	466	Oceanology	3
Geo	467	Marine Geology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF MARINE BIOLOGY

Araki, George S., Ph. D., Professor
Beeman, Robert C., Ph. D., Professor
Berrend, Robert E., Ph, D., Associate Professor
Bowen, Sarane T., Ph.D., Professor
Bradbury, Margaret G., Ph. D. Professor
Gustafson, Joel F., Ph.,D., Professor
Hensill, John S., Ph., D. Professor and Dean of the school of Natural Sciences
Martin, John H., Ph. D., Assistant Professor
Oberlander, George T., Ph. D., Professor
Swan, Lawrence W., Ph. D., Professor
Tomlinson, Jack T., Ph. D., Professor
Towle, Albert, Ph. D., Chairman and Professor
Yonenaka, Hideo H., Ph. D., Professor

To obtain further information, address all inquiries directly to :

Dr. Albert Towle, Chairman, Department of Marine Biology
California State University, San Francisco
1600 Holloway Avenue
San Francisco, California 94132

MOSS LANDING MARINE LABORATORIES
of the
California State Universities and Colleges
Moss Landing, California 95039

Five California State Universities (at Fresno, Hayward, Sacramento, San Francisco and San Jose) and the California State College at Stanislaus jointly operate this seaside facility as a year-around center for upper division and graduate level education and research in the marine sciences. An average of 40 units of course work, plus master's research and thesis, are provided every term (fall, spring, summer). The laboratories face west on Monterey Bay at the point of origin of a deep submarine canyon. To the east, Moss Landing Harbor opens upon the diversified intertidal marsh and mudflat habitats of Elkhorn Slough. The buildings provide 14,000 square feet of classroom, research, laboratory, office and library space, equipped to support the diversified curriculum and research needs of a multidisciplinary operation. Skiffs and small boats (8 to 24 feet) provide access to the nearshore marine and estuarine environments upon which the laboratories focus primary instructional and research emphasis. A privately owned 55-foot oceanographic vessel is affiliated with the laboratories, and is available for deeper water research on the continental shelf through cooperative arrangements with governmental and private organizations in the vicinity.

Since the Moss Landing Marine Laboratories are an integral part of six separate supporting institutions, degrees are earned through those schools. Baccalaureate and Master's degrees in the basic sciences (e.g., biology, chemistry, geology, meteorology) may include concentrations in the marine field, to include one or more semesters of study at the Moss Landing Marine Laboratories. While details differ in the several institutions, the following general notes apply.

1. B. A. or B. S. in Biology, Botany, or Zoology. Marine sciences requirements at Moss Landing Laboratories include general oceanography, marine ecology, marine science techniques, and quantitative marine science, plus electives appropriate to the major interest. In the California State Universities, a minimum of 124 units are required for the bachelor's degree, of which 45 must be in broad general education areas.

2. B. A. or B. S. in Geology. The marine sciences concentration will be similar to that for biology, with recommended electives including marine meteorology, marine biogenic sediments, and geological oceanography.

3. M. A. or M. S. in biology, geology, meteorology, or chemistry. Thirty graduate units, to include six to ten units of required core courses, and research and thesis are required for the master's degree. Some institutions also require reading competence in a foreign language. The marine sciences concentration usually includes a full year of work at the Moss Landing Marine Laboratories, with research and thesis on a marine environmental topic.

The Moss Landing Marine Laboratories curriculum supports two primary disciplines--marine biology and marine geology--for all six participating Universities and Colleges. Occasional course offerings also support majors in meteorology (California State University, San Jose), geography, and engineering. Special summer workshops and year-around seminar and special topics courses are designed for in-service marine sciences instruction of teachers at all levels.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

101	General Oceanography	4
102	Marine Science Techniques	3
103	Marine Ecology	4
104	Quantitative Marine Science	3
105	Marine Science Diving	3
106	Scuba Marine Research	3
111	Zoology Marine Vertebrates	4
112	Marine Birds and Mammals	4
113	Icthyology	4
121	Marine Invertebrate Zoology	4
122	Marine Invertebrate Embryology	4
123	Marine Invertebrate Physiology	4
131	Marine Algology	4
132	Marine Plankton	4
141	Geological Oceanography	3
142	Marine Biogenic Sediments	3
143	Coastal Geomorphology	3
171	Oceanographic Summer Cruise	4
172	Marine Environmental Group Research	3

GRADUATE COURSES

201	Concepts of Marine Science	3
202	Advanced Marine Science Techniques	4
203	Advanced Marine Ecology	3
211	Behavior of Marine Animals	3
221	Topics in Invertebrate Zoology	4
222	Biology of Mollusca	4
231	Physiology of Microscopic Marine Algae	4
232	Advanced Marine Plankton	4
241	Marine Protista & Protozoans	3
242	Continental Drift	3
251	Marine Geochemistry	4
252	Topics in Marine Chemistry	4
261	Kinematic Physical Oceanography	4
262	Dynamical Physical Oceanography	
263	Waves and Tides	
271	Population Biology	3
272	Marine Environmental Geology	3
277	Human Ecology of Monterey Bay	3
285	Graduate Seminar in Marine Biology	
286	Graduate Seminar in Marine Geology	
287	Graduate Seminar in Marine Chemistry	
288	Graduate Seminar in Physical Oceanography	
298	Research in Marine Science	1-4
299	Master's Thesis	1-4

The instructional staff for the courses listed above consists of the following:

BIOLOGY:

Cailliet, Gregor, Ph. D., Assistant Professor
Foster, Michael, Ph. D., Assistant Professor
Martin, John, Ph. D., Assistant Professor
Morejohn, G. Victor, Ph. D., Professor
Nybakken, James, Ph. D., Associate Professor
Thompson, Thomas, Ph. D., Assistant Professor

GEOGRAPHY

Gordon, Burton L., Ph. D., Professor
Treichel, Georg, Ph. D., Professor

GEOLOGY:

Arnal, Robert E., Ph. D., Professor
Broenkow, William W., Ph. D., Associate Professor
Hurley, Robert J., Ph. D., Professor

To obtain further information, address all inquiries directly to the office of:
Dr. Robert J. Hurley, Director
Moss Landing Marine Laboratories
P. O. Box 223
Moss Landing, California 95039

CAPE FEAR TECHNICAL INSTITUTE
Wilmington, North Carolina 28401

Cape Fear Technical Institute offers two 2-year marine programs. Marine Technology is ship-oriented while Marine Lab Technology is shore-side laboratory-oriented. Both emphasize hands-on training, purpose of producing a graduate capable of going to work in the marine field.

The shoreside facilities for marine programs at Cape Fear Technical Institute consist of: Laboratories for marine chemistry, marine biology, navigation, geology, microbiology and photography, workshops for oceanographic equipment, marine engines and netmaking.

The school's main oceangoing vessel, the 185-foot Advance II, can carry up to 70 students in addition to crew. This capability has given students the opportunity to participate on such projects as BOMEX, TEKTITE II, and IFYGL-72. The school also operates the 110-foot, oceangoing tug, the W. Dallas Herring, which can carry 10-15 students in addition to crew.

For nearshore and inshore work, students, under instructor supervision, are completely refurbishing the 75-foot Elm, the 55-foot Hutton, and a 38-foot vessel.

In addition to the formal curricula, the school sponsors a work-study cooperative program whereby selected marine students are released from the majority of their class load for a quarter or a portion of a quarter, to work for government agencies (N. C. State Fisheries, N. C. Dept. of Archives and History, Naval Oceanographic Office) or local industries. Credit is given based on the type of work and performance on the job.

Associate in Applied Science (A. A. S.) in Marine Technology. In 1972, 30 degrees were awarded. Requirement: successful completion of the following curriculum:

FIRST QUARTER

T-MAT	101-C	Technical Mathematics
T-MSC	111	Practical Fishing Operations
T-BIO	131	Marine Biology
T-MSC	206	Introduction to Oceanography
T-MSC	100	Small Boat Handling
T-PME	100	Shipboard Orientation
T-MSC	121	Ship Repair
T-SHI	101	Ship Experience (two weeks)

SECOND QUARTER

T-ENG	101	Grammar and Composition
T-MAT	102-C	Technical Mathematics
T-MSC	101	Basic Marine Piloting Techniques
T-PME	101	Reciprocating Internal Combustion Engines and Auxiliary Equipment
T-MSC	112	Practical Fishing Operations
T-BIO	132	Marine Biology
T-MSC	122	Ship Repair
T-SHI	102	Ship Experience (two weeks)

THIRD QUARTER

T-ENG	102	Grammar and Composition
T-MAT	103-C	Technical Mathematics
T-MSC	102	Navigational Publications & Electronic Procedures
T-PME	102	Reciprocating Internal Combustion Engines and Auxiliary Equipment
T-MSC	113	Practical Fishing Operations
T-PHY	101	Physics: Properties of Matter
T-MSC	123	Ship Repair
T-SHI	103	Ship Experience (two weeks)

FOURTH QUARTER

T-MAT	201	Technical Mathematics
T-MSC	103	Navigation and Cartography
T-MSC	114	Practical Fishing Operations
T-CHM	103	Marine Chemistry Lab Operations
T-MSC	130	Basic Oceanographic Equipment
T-MSC	213	Marine Fishery Science
T-MSC	124	Ship Repair
T-SHI	104	Ship Experience (two weeks)
T-SHI	109	Ship Experience overtime

FIFTH QUARTER

T-ENG	204	Oral Communication
T-DFT	117	Drafting and Blueprint Reading
T-PHY	102	Physics: Work, Energy, Power
T-MSC	207	Oceanographic Data: Acquisition and Reducation
T-MSC	131	Special Oceanographic Instrumentation
T-PSY	206	Applied Psychology
T-MSC	125	Ship Repair
T-SHI	105	Ship Experience (two weeks)

SIXTH QUARTER

T-ELC	107	Electricity I
T-MSC	208	Oceanographic Data: Calculations & Graphics
T-GEO	101	Geology
T-MSC	132	Marine Geological Equipment
T-SOC	102	Principles of Sociology
T-MAT	211	Basic Statistics
T-MSC	126	Ship Repair
T-SHI	106	Ship Experience (two weeks)

SEVENTH QUARTER

T-MSC	211	Nearshore and Estuarine Survey Methods
T-BIO	110	Field Biology
T-MAT	212	Basic Statistics
T-SOC	206	American Institutions
T-MSC	134	Marine Welding
T-ELC	108	Electricity II
T-MSC	127	Ship Repair
T-SHI	107	Ship Experience (two weeks)

EIGHTH QUARTER

T-ENG	103	Reporting Writing
T-MSC	210	Chemical Oceanography & Primary Production
T-BIO	133	Biological Sampling Techniques
T-MSC	133	Oceanographic Equipment
T-PME	103	Marine Diesel Engines
T-ELC	109	Electricity III
T-MSC	128	Ship Repair
T-SHI	108	Ship Experience (two weeks)
T-SHI	109	Ship Experience overtime

Associate in Applied Science (A. A. S.) in Marine Laboratory Technology. In 1972 15 degrees were awarded Requirement : Successful completion of the following curriculm:

FIRST QUARTER

T-ENG	101	Grammar and Composition
T-MAT	101-C	Technical Mathematics
T-BIO	131	Marine Biology
T-MSC	206	Introduction to Oceanography
T-MSC	100	Small Boat Handling
T-MSC	117	Science Field Trip
T-PSY	206	Applied Psychology

SECOND QUARTER

T-ENG	102	Grammar and Composition
T-MAT	102-C	Technical Mathematics
T-BIO	132	Marine Biology
T-CHM	101	Introduction to Chemistry
T-MSC	201	Aquarium Systems
T-MSC	118	Science Field Trip

THIRD QUARTER

T-ENG	103	Report Writing
T-MAT	103-C	Technical Mathematics
T-PHY	101	Physics: Properties of Matter
T-MSC	215	Oceanographic Instrumentation
T-CHM	108	Practical Analysis of Seawater
T-MSC	119	Science Field Trip

FOURTH QUARTER

T-ENG	204	Oral Communication
T-MAT	201	Technical Mathematics
T-CHM	109	Pratical Analysis of Seawater
T-PHY	102	Physics: Work, Energy, Power
T-BIO	111	Microbiology
T-MSC	217	Science Field Trip

FIFTH QUARTER

T-MSC	216	Oceanographic Data
T-ELC	107	Electricity I
T-MAT	211	Basic Statistics
T-SOC	102	Principles of Sociology
T-GEO	101	Geology
T-MSC	218	Science Field Trip
T-PHO	110	Photography

SIXTH QUARTER

T-MSC	220	Special Problem
T-ELC	108	Electricity II
T-SOC	206	American Institutions
T-MSC	213	Marine Fishery Science
T-MSC	203	Estuarine Pollution Problems
T-MAT	212 2	Basic Statistics

Instructional Staff for the courses above are:

Adams, James, Fishing Operations
Buck, Dale R., Oceanography, Chemistry
Burns, Francis A., Master, Advance II
Carter, Marie, Marine Lab Technician
Foss, Edward L., Chairman Marine Technology Division, Oceanography
Gladding, Thomas, Jr., Navigation
Jordan, Arthur W., Coordinator of Ship Operations and Chief Investigator for Sea Grant
Lewis, Edward, Chief Mate
McClelland, Roy L., Marine Engineering
McNamara, John, First Engineer
Malpass, Mitchell, Marine Technician
Martin, James, R., Marine Biology
Meyland, Sarah J., Oceanography, Geology, Photography
Miller, Mark, Marine Technician
Newbegin, Gary, Second Engineer
Pitts, Edmund, Third Engineer
Raynor, Bruce, Asst. Marine Superintendent, Ship Repair
Remington, George L., Marine Electronics, Physics
Rhodes, S. Thomas, Marine Biology
Thomas, David, Marine Technician
Watson, Harold, Chief Engineer
Wolfe, Ernest, Second Mate

For further information, all inquiries should be made to:

Mr. Carl E. Malpass
Acting Dean, Student Affairs
Cape Fear Technical Institute
411 North Front St.
Wilmington, N. C. 28401

CASE WESTERN RESERVE UNIVERSITY
Cleveland, Ohio 44106

The Department nf Geology and the Division of Fluid, Thermal and Aerospace Sciences of the School of Engineering at Case Western Reserve University jointly administer an interdisciplinary program in geophysical fluid dynamics.

The principal facilities are located on the Case Western Reserve campus as well as on the university-owned Squire Valleeview Farm about 10 miles east of the university. Among the experimental facilities are a low turbulence subsonic wind tunnel, a low turbulence water tunnel, a water table, as well as many small air and water flow facilities. The laboratories are well equipped with high precision flow and temperature measuring equipment including hot wire and hot film anemometers, a number of laser doppler velocity measurement devices. There are also water analysis facilities including analysis by radioactive tracers. Well-equipped, manned central shops and instrument rooms are available as well as a controlled environment room for experiments where extreme precision is important. A 25-acre watershed area at Squire Valleeview Farm is being used for a study of ecological system dynamics. Geophysical and oceanographic measurements in Lake Erie are made through cooperation with the U. S. Coast Guard. A Univac 1108 computer is available at the university's computing center.

The program itself is a graduate program leading to M. S. and Ph. D. degrees. The course requirements are as follows:

M. S. (Geophysical Fluid Dynamics). Six courses including EFTS 453 Geophysical Fluid Dynamics plus a thesis in the area of geophysical fluid dynamics.

Ph. D. An additional eight to 10 courses including two math courses, some in physics, geochemistry, etc., plus a doctoral dissertation.

Six M.S. and two Ph. D. degrees have been granted under the program since its inception in 1969. There

are 10 students in the program in the 1972-73 academic year.

The following courses are offered in conjunction with the above programs:

EFTS 450	Analytical Fluid Mechanics
EFTS 452	Viscous Flow I
EFTS 453	Geophysical Fluid Mechanics I
EFTS 454	Theoretical Meteorology
EFTS 552	Viscous Flow II
EFTS 554	Turbulent Fluid Motion
EFTS 555	Approximation Methods in Engineering Analysis
EFTS 556	Geophysical Fluid Mechanics II
EFTS 557	Convection Heat Transfer
EFTS 558	Conduction and Radiation
EFTS 559	Kinetic Theory
EFTS 655	Theories of Hydrodynamic Stability
GEOL 321	Geology of Water Resources
GEOL 323	Applied Geophysics
GEOL 334, 335	Earth Environmental Science Seminar
GEOL 350	Geochemistry
GEOL 364	Descriptive Meteorology
GEOL 366	General Oceanography
GEOL 425	Geotectonics
GEOL 435	Geochemistry
GEOL 453	Physical Limnology

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Teraguchi, Mitsuo, Ph.D., Assistant Professor

FLUID, THERMAL AND AEROSPACE SCIENCES

Greber, Isaac, Ph.D., Professor
Janowitz, Gerald S., Ph.D., Assistant Professor
Kaplan, Shimon, Ph.D., Assistant Professor
Ostrach, Simon, Ph.D., Professor
Prahl, Joseph M., Ph.D., Assistant Professor
Reshotko, Eli, Ph.D., Professor

GEOLOGY

Fisher, Perry W., Ph.D., Assistant Professor
Helwig, James A., Ph.D., Assistant Professor
Hower, John, Ph.D., Professor
Lick, Wilbert J., Ph.D., Professor

For additional information, address all inquiries directly to:

Professor Eli Reshotko
Head, Division of Fluid, Thermal and Aerospace Sciences
Case Western Reserve University
Cleveland, Ohio 44106
(216) 368-2941

THE CATHOLIC UNIVERSITY OF AMERICA
Washington, D. C.

The Institute of Ocean Science and Engineering was established at the University in 1967 to foster research and academic programs in the marine sciences. The major areas of marine related research are: underwater acoustics, properties of transducers, structure and physical properties of salt water, marine cables, instrumentation, fluid dynamics, soil mechanics and physical properties of water laboratories. The university has participated in a cooperative program with three local Naval laboratories since 1967. This program sponsors mutual use of research facilities and oceanographic ships.

Computer facilities include IBM 1620 and 1130 computers and a PDP-10 computer. The university is a member of the Washington Consortium of Universities and The Marine Science Consortium of Pennsylvania Colleges and Universities. The university offers undergraduate and graduate programs at its main campus in northeast Washington, D.C. and at the Delaware Bay Marine Science Center of the Marine Science Consortium in Lewes, Delaware.

The following degrees are offered in ocean engineering and related fields:

D. Engr. or Ph.D. in Ocean Engineering (Department of Civil and Mechanical Engineering). Candidates for the doctorate in ocean engineering must satisfactorily complete two years of full-time resident graduate study beyond the master's degree, or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the bachelor's degree), 18 credit hours in a minor field (usually mathematics) or 12 credit hours in a first minor field and 6 credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of dissertation. Doctoral programs in ocean engineering are tailored to meet the needs of the individual student. Candidates may specialize in fluid or solid mechanics, heat transfer or thermodynamics, control system or underwater acoustics. All doctoral candidates in ocean engineering must take a minimum of nine credit hours in pure or applied oceanography, six one-semester upper-level graduate courses in their specialty area, and acquire appropriate at-sea experience.

M.S.E. in Ocean Engineering (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in ocean engineering are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent or a part-time or three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

D. Engr. or Ph.D. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the Doctorate in engineering acoustics must satisfactorily complete two years of full-time resident graduate study beyond the master's degree, or its equivalent on a part-time or three-quarter time basis. Degree requirements may be summarized as follows: a major course program (a minimum of 35 credit hours beyond the Bachelor's degree), 18 credit hours in a minor field (usually mathematics) or 12 credit hours in a first minor field and six credit hours in a second minor field, written comprehensive examinations in the major and first minor fields, a reading knowledge of one foreign language, a dissertation, and an oral defense of the dissertation.

M.S.E. in Engineering Acoustics (Department of Civil and Mechanical Engineering). Candidates for the degree of Master of Science in Engineering (acoustics) are required to satisfactorily complete one year of full-time graduate study (a minimum of 24 credit hours including research and seminars), or its equivalent on a part-time or three-quarter time basis. A comprehensive examination in the major field plus a thesis is required. There are no foreign language requirements for the M.S.E. degree.

B.S.E. (Ocean Engineering Option) (Department of Civil and Mechanical Engineering). Undergraduate students in this program follow the same curriculum as other mechanical engineering students during the freshman and sophomore years. Required ocean engineering courses in the junior and senior year are Engineering Properties of Materials, Physical Oceanography and Dynamic Measurements. The other required courses follow the C.M.E. curriculum. Projects related to ocean engineering are included in the laboratory and design courses.

Fifteen semester hours of electives in the senior year may be selected from the list of mechanical and ocean engineering courses at the senior and the beginning graduate level.

The following courses are offered in conjunction with the above programs:

GRADUATE

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

501	Structural Mechanics I	3
502	Structural Mechanics II	3
503	Introduction to Continuum Mechanics	3
504	Physical Oceanography	3
505	Advanced Design	3
506	Advanced Design	3
507	Introduction to Ocean Engineering	3
508	Ocean Waves	3
509	Materials for Ocean and Other Extreme Environments	3
511	Limit Analysis of Structures	2
512	Structural Analysis	3
514	Geological Oceanography	3
515	Structural Dynamics	3
517	Fundamentals of Instrumentation	3
532	Experimental Dynamics Laboratory	3
534	Experimental Stress Analysis	3
541	Classical Mechanics	3
545	Foundation of Fluid Mechanics	3
546	Inviscid Incompressible Flows	3
547	Inviscid Compressible Flows	3
548	Incompressible Viscous Flows	3
554	Applied Underwater Acoustics	3
561	Heat Transfer	3
562	Heat Transfer	3
564	Theory of Waves	3
565	Control System Analysis and Synthesis	3
566	Control System Analysis and Synthesis	3
568	Electromechanical Circuits and Transducers	2
571	Theoretical Thermodynamics	3
572	Theoretical Thermodynamics	3
581	Introduction to Acoustics	3
582	Environmental Noise and its Control	2
597	Seminar	1
598	Seminar	1
701	Design of Complex Systems	3
702	Design of Complex Systems	3
704	Theory of Plasticity	2
705	Theory of Shells and Plates	3
706	Nonlinear Elasticity	3
707	Propagation of Sound in the Sea	3
708	Theoretical Elasticity	3
709	Radiation and Scattering I	3
710	Radiation and Scattering II	3
712	Acoustic Signal Processing	3
718	Stability of Structures	3
733	Viscous Gas Dynamics	3
734	Separation of Flow	3
735	Experimental Stress Analysis II	3
736	Experimental Stress Analysis III	3
741	Vibrations in Elastic Solids	3
742	Acoustic Radiation from Submerged Structures	3
743	Hypersonic Gas Dynamics	3
744	Hypersonic Gas Dynamics	3
768	Propagation in Random Media	3
797	Research	3
798	Research	3
995	Master's Dissertation Guidance	0
996	Master's Dissertation Guidance	0
997	Doctoral Dissertation Guidance	0
998	Doctoral Dissertation Guidance	0

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Andrews, Frank A., Ph. D., Professor of Acoustics
Casarella, Mario J., Ph. D., Associate Professor of Ocean Engineering
Chang, Paul K., Ph. D., Professor of Fluid Mechanics
Chi, Michael, Ph. D., Professor of Structural Mechanics
Durelli, August J., Ph. D., Professor of Stress Analysis
Gilheany, John J., Ph. D., Associate Professor of Ocean Engineering
Heller, Samuel R., Ph. D., Professor and Chairman of Civil and Mechanical Engineering (Ocean Engineering)
Jackson, Francis J., Ph. D., Adjunct Professor of Acoustics
Kelnhofer, William J., Ph. D., Associate Professor of Fluid Mechanics
Magrab, Edward B., Ph. D., Associate Professor of Acoustics
Parks, Vincent J., Ph. D., Associate Professor of Stress Analysis
Perrone, Nicholas, Ph. D., Adjunct Professor of Structural Mechanics
Smith, Russell A., Ph. D., Associate Professor of Fluid Mechanics
Soteriades, Michael C., Ph. D., Professor of Structural Mechanics
Spooner, Ronald, Ph. D., Adjunct Professor of Acoustics
Thiruvengadam, Alagupillai, Ph. D., Associate Professor of Ocean Engineering
Tsao, Chi-Kung, Ph. D., Associate Professor of Heat Transfer
Vaishnav, Ramesh N., Ph. D., Professor of Structural Mechanics

DEPARTMENT OF AEROSPACE AND ATMOSPHERIC SCIENCES

Atabek, Bulent H., Ph. D., Professor of Fluid Mechanics
Chang, Chieh Ç., Ph. D., Professor and Chairman of Aerospace and Atmospheric Sciences (Atmospheric Vortices)
Eisler, Thomas J., Ph. D., Professor of Acoustics
Kao, Timothy W., Ph. D., Professor of Geophysical Fluid Mechanics
Lee, Kai F., Ph. D., Associate Professor of Atmospheric Physics
Ling, Sung C., Ph. D., Professor of Fluid Mechanics
Pao, Hsien P., Ph. D., Professor of Geophysical Fluid Mechanics
Whang, Yun C., Ph. D., Professor of Fluid Mechanics

To obtain further information, address all inquiries directly to:

Dr. Mario J. Casarella
Institute of Ocean Science and Engineering
Catholic University of America
Washington, D. C. 20017

CHARLES COUNTY COMMUNITY COLLEGE
La Plata, Maryland 20646

Estuarine Resources Technology, a division of the Department of Biology, operates teaching and re-

search centers at Benedict, Maryland and at the main campus in La Plata, Maryland.

The principle teaching and research center at Benedict Maryland is located on the Patuxent River, an arm of the Chesapeake Bay, and is a prime stripped bass and oyster producing area. The Benedict center, soon to be expanded to more than double its present size, is composed of separate chemical and biological studies buildings. Three vessels, the 36-foot R. V. Truitt, the 26-foot Menedia, and the 18-foot Sea Squirt are based at Benedict and used in training cruises on the Patuxent River and Chesapeake Bay.

Facilities at the main campus include an aquatics lab, microbiological lab with two walk-in environment chambers, chemical instrumentation lab, sanitary chemical lab, data processing center equipped with an IBM 360-60 computer, and a large shop area. Specialized equipment located at the main campus includes infrared and ultraviolet spectrophotometers, atomic absorption, gas chromatography, total carbon analyzers, pesticide monitoring units and a photography lab.

The Estuarine Resources Technology program trains in two years a research assistant, capable of performing a wide variety of field and laboratory functions in the estuarine and freshwater environments. The program focuses on practical field studies conducted in small groups for eight hours one day a week. Sophomore students may take either a field or laboratory option.

An Associate of Arts degree in Estuarine Resources Technology is granted students completing a minimum fo 62 hours of credit in required and optional courses.

The following courses are offered in conjunction with the above program:

Bio	100	Theory and Techniques of Field Sampling	3
Bio	107	Principles of Estuarine Ecology	4
Bio	105	Concepts of Biology	3
Math	150	Technical Mathematics	4
Math	151	Technical Mathematics	4
Chem	120	General Chemistry	4
Chem	121	General Chemistry	4
Eng	101	Composition and Rhetoric	3
Sph	103	Business and Professional Speaking	3
Bio	251	Applied Estuarine Ecology	4
Bio	252	Estuarine Problem Analysis	4
Bio	201	Microbiology	4
Eng	205	Report Writing	3
Chem	155	Instrumentation	4
Chem	252	Sanitary Chemistry	3
Math	230	Statistics	3
Bio	210	Fishery Biology	3
Bio	211	Fishery Management	3
Pat	103	Wastewater Operations	3
Pat	205	Industrial Waste	3
Bio	106	Aquatic Ecology and Water Pollution	3
Bio	202	Marine Biology	3
Bio	204	Physical Oceanography	3
Bio	207	Marine Geology	3
Bio	208	Marine Instrumentation	3
Bio	229	Waves and Tides	3

The instructional staff for the courses listed above cosists of the following:

BIOLOGY

Jensen, B. L., Professor
Montgomery, W. E., Assistant Professor
Poe, T. R., Assistant Professor
Rigley, L., Assistant Professor

CHEMISTRY

Engel, W. E., Assistant Professor
Sotera, J. A., Assistant Professor

To obtain further information contact:

Mr. Thomas Poe, Co-ordinator
Estuarine Resources Technology
Charles County Community College
Box 910
La Plata, Maryland 20646

UNIVERSITY OF CHICAGO
Chicago, Illinois 60637

The marine sciences program at the University of Chicago is within the Department of the Geophysical Sciences, located in the Henry Hinds Laboratory for the Geophysical Sciences. The central core of the building consists almost entirely of research laboratories and associated shop facilities. Among these are several wave tank laboratories which include wave tanks up to 80 feet long used for impulse wave and ocean wave studies, random wave and interaction studies, and internal wave investigations. Other facilities include a flume, wind tunnel, paleoecology laboratory, sedimentology laboratory, hydrodynamics laboratory, geochemistry laboratories, an electron microprobe, and X-ray diffraction equipment. The university computing center is nearby. Field facilities are available through cooperation with the Woods Hole Oceanographic Institution.

Degrees are not offered specifically in the marine sciences or oceanography. The M.S. and Ph.D. degrees in the Geophysical Sciences are offered with specialization in the areas included within the marine sciences.

Master of Science (Geophysical Sciences). The requirements for this degree are: a program of study approved by the departmental counselor, normally consisting of nine graduate courses (at least three basic science courses and at least three geophysical sciences courses and at least one research course); courses in basic science may be taken in or outside the department, and an average grade of not lower than B and no grade lower than C in the courses offered for the degree.

Doctor of Philosophy (Geophysical Sciences). The requirements are: a program of study approved by the student's advisory committee, normally consisting of at least nine graduate courses; pass a reading comprehension examination in two modern foreign languages, one of which must be russian or german, a preliminary examination consisting of a written part covering fields that the student has selected for his program of study, followed by an oral part based on the student's proposal for a dissertation topic that he has submitted as a research prospectus, and a dissertation by the candidate on the results of independent research in the geophysical sciences, followed by an oral final examination on the dissertation and the field of specialization.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

132	Evolution of the Biosphere	3
133	The Atmosphere and Oceans	3
222	Oceans and Atmospheres of the Geological Past	3
232, 233	Dynamics and Phenomenology of the Atmosphere and Oceans	3

GRADUATE

302	Hydrodynamic Stability	3
303	Turbulence	3

304	Advanced Topics in Rotating Fluids	3
320	Marine Paleoecology	3
343	Ocean Wave Theory	
348	Shallow-water Oceanography	3
351	Geophysical Fluid Dynamics I: Fundamentals	3
352	Geophysical Fluid Dynamics II: Viscous Flows	3
353	Geophysical Fluid Dynamics III: Waves	3
354	Geophysical Fluid Dynamics IV: Large-scale Atmospheric Motions	3
355	Geophysical Fluid Dynamics V: Large-scale Oceanic Motions	3
356	Geophysical Fluid Dynamics VI: Laboratory Models	3
361	Atmospheric Convection	3
362	Numerical Weather Prediction	3
364	Dynamics of Atmospheric Vortices	3
381	Tides of the Geosphere	3
385	Seminar: Sediment Transport I	3

RESEARCH COURSES

441	Research in Dynamical Oceanography	3
460	Research in Geophysical Fluid Dynamics	3
461	Research in Dynamical Prediction	3
462	Research in Hydrodynamical Models	3
463	Research in Experimental Hydrodynamic Stability	3
464	Research in Convection	3
466	Research in Theoretical Fluid Mechanics	3
481	Research in Marine Geophysics	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF GEOPHYSICAL SCIENCES

Fultz, Dave, Ph. D., Professor of Meteorology
Johnson, Ralph G., Ph. D., Professor of Paleontology
Kuo, Hsiao-Lan, Ph. D., Professor of Meteorology
McGoldrick, Lawrence F., Ph. D., Associate Professor of Fluid Mechanics
Miller, Robert L., Ph. D., Professor of Geophysics and Admissions Counselor
Pedlosky, Joseph, Ph. D., Professor of Geophysical Fluid Dynamics
Platzman, George W., Ph. D., Professor of Meteorology
Schopf, Thomas J. M., Ph. D., Associate Professor of Paleobiology
Srivastava, Ramesh C., Ph. D., Associate Professor of Meteorology

To obtain further information, address all inquiries directly to:

Professor George W. Platzman
Chairman, Department of Geophysical Sciences
The University of Chicago
5734 South Ellis Avenue
Chicago, Illinois 60637

CITY UNIVERSITY OF NEW YORK
New York, New York 10031

The City University Institute of Oceanography is the central focus for an oceanographic and meteorological program that reaches many of the 21 individual campuses of the City University of New York. The institute office is located at the City College, but the 90-foot research ship, Atlantic Twin, is based on Staten Island, New York. A dock and shore facility is planned for the Bronx. Special laboratories in sediments, hydraulics, marine microbial exology, sewage effluent aquaculture, plankton dynamics, air-sea interactions, and chemical oceanography, among others, are available on at least one or another campus. Students have access to the mariculture laboratory on St. Croix, U. S. Virgin Islands, littoral collecting equipment, combined library holdings of over two million books and 10,000 periodicals and assorted computers. The institute has long-standing cooperative arrangements with many other marine institutions including, in the immediate area, the Lamont-Doherty Geological Observatory.

The following degrees are offered:

1. B. S. in Oceanography, interdisciplinary group in oceanography. This degree is available only at the City College. Students are required to complete 128 credits with an average of "C" or better. Students must take a minimum of 44 credits outside their major subject and a minimum of 36 credits in their major. Up to 16 credits of non-major studies may be taken on a pass-fail basis. Degrees granted in 1972: 35.

2. M. A. in Biology, Chemistry, Earth and Planetary Science, and Physics, Departments of Biology, Chemistry Earth and Planetary Science, and Physics. Generally speaking, students must complete 30 credits of an approved program of study with an average grade of "B" or better. Details vary regarding the language requirement and/or computer language, thesis requirement and comprehensive examination. Degrees granted in 1972: six.

3. Ph. D. in Biology, Chemistry, and Physics, executive committees in each discipline. Degree requirements vary in detail, but students must generally complete 60 credits of partially prescribed work, including thesis research, with distinction. Students must also pass a first and second examination in their discipline, and must defend their thesis. External examiners are usually included on examination committees. Degrees granted in 1972: Two

4. Interdisciplinary Doctoral Program in Oceanography interdisciplinary committee in oceanography. A recently begun program designed to meet the needs of students who are trying to do cross-disciplinary lines, and therefore fail to fit or need the relatively inflexible requirements of a standard discipline. Students with unusual backgrounds and interests will be carefully screened by the committee and, after nominal assignment to a specific discipline, will have the course of study determined by a special committee. This committee may ask waivers of certain degree obligations, and require others. No degrees granted in this new program.

5. Ph. D. in Marine and Atmospheric Studies, executive committee in marine and atmospheric studies. This program is proposed and is now being reviewed.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Bio	111	Biology of Vertebrates	4
Bio	112	Biology of Invertebrates	4
Bio	113	Biology of Plants	4
Bio	216	Principles of Ecology	2
Bio	221	Lower Plants	4
Bio	274	Biological Oceanograhpy	4
Bio	298	Independent Study - Honors	4
Chem	12	Inorganic Chemistry	3
Chem	30-33	Physical Chemistry	10
Chem	46	Chemical Instrumentation	4
Chem	59	Biochemistry	4
Chem	60-64	Organic Chemistry	10
(EPS)	68	Chemical Oceanography	4
(EPS)	301-304	Honors	12
EPS	27, 28	Structural Geology	8
EPS	30, 31	Stratigraphy	8
EPS	25	Sedimentation and Sedimentary Petrography	4
ESP	42, 43	Synoptic Meteorology	8
EPS	45	Hydrology	3
EPS	51	Statistical Methods in Metorology	4

EPS	- 53	Weather Forecasting	4
EPS	61	Introduction to Geophysics	4
EPS	64	Physical Oceanography	4
EPS	65	Marine Geology	4
EPS	70, 72	Field Geology	9
EPS	90-94	Selected Topics in Geology and Geological Oceanography	12
EPS	95-99	Selected Topics in Meteorology and Physical Oceanography	12
EPS	301-304	Honors	12
Phys	9-10	Mechanics	6
Phys	11-12	Electricity and Magnetism	6
Phys	13	Thermodynamics	4
Phys	37	Wave-motion and Acoustics	3
Phys	55	Physical Meteorology	3
Phys	56	Dynamic Meteorology	3
Phys	57	Physics of the Upper Atmosphere	3
Phys	99	Selected Topics in Physics	4

GRADUATE

Bio	762,.1	Physiological Ecology	6
Bio	760,.1	Community Ecology	3
Bio	760.5	Population Ecology	3
Bio	761.1,2	Marine Plankton Dynamics	6
Bio	761.3,4	Marine Benthos	6
Bio	761.5,6	Fishes and Fisheries Biology	6
Bio	761.7,8	Marine Microbiology	6
Bio	761.9	Marine Ecology	4
Bio	780	Mathematical Biology	3
Bio	761.11,12	Principles and Practices of Aquaculture	6
BioChem	889.1	Metabolism of the Sea	6
Chem	710	Advanced Inorganic Chemistry	3
Chem	750-1	Advanced Organic Chemistry	6
Chem	810	Doctoral Research	var
EPS	1710	Structural Geology	4
EPS	1714	Geophysics	3
EPS	1732	Paleoecology	3
EPS	1740	Sedimentology	3
EPS	1743	Sedimentary Petrology	3
EPS	1770	Principles of Geochemistry	3
EPS	1790	Seminar	4
EPS	1795	Thesis Research	3
EPS	1773	Low Temperature Geochemistry	3

The instructional staff for the courses listed above consists of:

POLICY COUNCIL OF THE UNIVERSITY INSTITUTE OF OCEANOGRAPHY

Donn, William L., Ph. D., Professor of Earth and Planetary Science.
Lee, John J., Ph. D., Professor of Biology.
McIntyre, Andrew, Ph. D. Associate Professor of Earth and Environmental Science, Queens College.
Posner, Gerald S., Ph. D. Acting Director and Professor of Biology.
Roels, Oswald, Ph. D., Professor of Oceanography.

Thurber, David, Ph. D., Professor of Earth and Environmental Science, Queens College
Tietjen, John H., Ph. D., Associate Professor of Biology.

UNIVERSITY INSTITUTE OF OCEANOGRAPHY

Pierson, Willard, Ph. D., Professor of Oceanography
Posmentier, Eric, Ph. D., Assistant Professor of Oceanography.
Roels, Oswald, Ph. D., Professor of Oceanography

BIOLOGY

Be Allan, Ph. D., Adjunct Associate Professor of Biology
Berg, Carl, Ph. D., Assistant Professor of Biology.
Goldstein, Solomon, Ph.D., Associate Professor of Biology, Brooklyn College.
Hecht, Max, Ph. D., Professor of Biology, Queens College.
Koulish, Sasha, Ph. D., Assistant Professor of Biology, Richmond College.
Malone, Thomas, Ph. D., Assistant Professor of Biology.
Pierce. Stanley, Ph. D., Associate Professor of Biology, Queens College
Rachlin, Joseph, Ph. D., Associate Professor of Biology, Lehman College.
Roze, Janis, Ph. D., Associate Professor of Biology.
Sacks, Martin, Ph. D., Professor of Biology.
Shields, Robert W., Ph. D., Associate Professor of Biology.
Smith, C. L., Adjunct Associate Professor of Biology
Tavolga, William N., Ph. D., Professor of Biology.

CHEMISTRY

Barrett, Edward, Ph. D., Associate Professor of Chemistry, Hunter College.
Blei, Ira C., Ph. D., Associate Professor of Chemistry, Richmond College.
Garside, Christopher, Ph. D., Assistant Professor of Earth and Planetary Science.
Haines, Thomas H., Ph. D., Associate Professor of Chemistry.
Soloway, Saul, Ph. D., Associate Professor of Chemistry.

EARTH AND PLANETARY SCIENCE

Burckle, Lloyd, Ph. D., Assistant Professor in Geology, Hunter College.
Coch, Nicholas, Ph. D., Associate Professor of Earth and Environmental Science, Queens College.
Ehrlich, Albert, Ph. D., Associate Professor of Earth and Planetary Science.
Fagan, John, Ph. D., Assistant Professor of Earth and Planetary Science.
Feeley, Herbert, Ph. D., Associate Professor of Earth and Environmental Science, Queens College.
Franke, Lehn, Ph. D., Assistant Professor of Earth and Planetary Science.
Gedzelman, Stanley, Ph. D., Assistant Professor of Earth and Planetary Science.
Habib, Daniel, Ph. D., Associate Professor of Earth and Environmental Science, Queens College.
Herron, Thomas, Ph. D., Associate Professor of Earth and Planetary Science.
Krinsley, David, Ph. D., Professor of Earth and Environmental Science, Queens College.
Loring, Arthur, Ph. D., Assistant Professor of Geology, York College.
Mencher, Ely, Ph. D., Professor of Earth and Planetary Science.
Neumann, Gerhard, Ph. D., Professor of Earth and Planetary Science.
Newman, Walter S., Ph. D., Associate Professor of Earth and Environmental Science. Queens College.
Schaffel, Simon, Ph. D., Assistant.
Schreiber, Edward, Ph. D., Associate Professor of Earth and Environmental Science, Queens College.
Spar, Jerome, Ph. D., Professor of Earth and Planetary Science.

PHYSICS

Guthrie, Albert, Ph. D., Professor of Physics, Brooklyn College.
Stolov, Harold, Ph. D., Professor of Physics.

Thorndike, Edward, Ph. D., Professor of Physics, Queens College.

To obtain further information, address all inquiries directly to:

Dr. Gerald S. Posner, Acting Director
University Institute of Oceanography
The City College of the City University of New York
Convent Avenue at 138th Street
New York, New York 10031
(212) 621-2607

QUEENS COLLEGE
OF THE CITY UNIVERSITY OF NEW YORK
Flushing, New York 11367

Queens College is a part of the City University of New York and oceanographic studies at all levels through the Ph.D. are coordinated through the Institute of Oceanography of the City University. Queens College offers a number of programs with oceanographic orientation on the undergraduate level and also grants an M.A. degree in marine geology.

The college has use of institute facilities, including the 90-foot research vessel Atlantic Twin, a wide range of equipment for oceanographic research and dock-side laboratories at St. George, Staten Island. Research equipment at Queens College includes instruments for stable and radioisotope studies, an atomic absorption spectrometer, infrared gas analyzers, gas chromatographs and X-ray diffraction and spectrometry equipment. A wide range of other equipment for chemical, biological and geological investigations is also available in the laboratories of the college.

The B.A. degree (128 credits) may be achieved in several ways:

1. A major in one of the sciences or mathematics and nine or more credits in oceanography courses. A student wishing to become a physical oceanographer should major in physics or mathematics. A student with interests in marine engineering may begin with the pre-engineering programs at the college.
2. A choice of two programs may be made through the Department of Earth and Environmental Sciences:
   a. For students with an interest in scientific aspects of oceanography or oceanographic education, 18 credits from within the department and at least 15 credits of advanced science courses appropriate to the student's goals from other departments.
   b. For students in social aspects of oceanography, admiralty and marine law, science journalism and the like, 18 credits from within the department and 15 credits of advanced work appropriate to the student's goals in one other department.
3. For exceptional students with more than usually well-defined goals, individually tailored programs may be arranged through the Honors and Interdisciplinary Studies Program.

The M.A. in Marine Geology includes the following requirements: 30 credits of approved graduate courses including structural geology and a field course, a written dissertation and oral defense, a reading knowledge of an approved foreign language, and a written comprehensive examination.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

EES 8	Introduction to Oceanography	3
EES 55	General Oceanography	3
EES 56	Physical and Chemical Oceanography	3
EES 57 (Bio 57)	Principles and Practice of Oceanographic Research	3
Bio 56	Marine Biology	3
Phys Ed 5	Aquatics	various

GRADUATE

EES 507	Oceanography of New York and Adjacent Waters	3
EES 780	Marine Geology	3
EES 773	Low Temperature Geochemistry	3
EES 740	Sedimentology	3
EES 757	Geomorphic Processes	3

The instructional staff for the courses listed above consists of the following:

EARTH AND ENVIRONMENTAL SCIENCES

Coch, Nicholas, Ph. D., Associate Professor
Feely, Herbert, Ph. D., Associate Professor
McIntyre, Andrew, Ph. D., Associate Professor
Schreiber, Edward, Ph. D., Professor
Takahashi, Taro, Ph. D., Distinguished Professor
Thurber, David, Ph. D., Professor

CHEMISTRY

Locke, David, Ph. D., Associate Professor

BIOLOGY

Pierce, Stanley, Ph. D., Associate Professor

HEALTH AND PHYSICAL EDUCATION

Loret, John, Lector Degree, Assistant Professor
Magel, John, Ph. D., Associate Professor
McArdle, William, Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. David L. Thurber
Department of Earth and Environmental Sciences
Queens College
Flushing, New York 11367

CLATSOP COMMUNITY COLLEGE
Astoria, Oregon 97103

Clatsop Community College has participated since 1968 in the National Sea Grant Program in cooperation with Oregon State University. The geographical location of the college, 12 miles from the Pacific Ocean on the Columbia River, provides the needed resources for successfully conducting the program. The Columbia River is well suited for preliminary training in seamanship, commercial fishing and oceanographic techniques. The area provides sheltered water for training in techniques of handling instruments, plankton tows, water sampling, salinity tests, etc.

The college operates three boats, 50 feet, 26 feet and 24 feet long. In addition, use is made of a commercial fishing boat and Oregon State University's R/V Sacajawea, a 37-foot cabin cruiser.

Clatsop Community College offers the Associate Degree in Science in oceanographic technology, marine engineering technology, commercial fishing technology and marine technology. All students are required to complete a min-

imum of 90 term hours of approved course work with a minimum grade point average of 2.00. A minimum of 18 term hours of general education courses and three term hours of personal health are required. The student must be in attendance at Clatsop Community College at least two terms including the last term before the degree is awarded and must have completed 24 hours at the college. A major emphasis is placed on both classroom and sea experience.

The college offers to the student either a two-year vocational degree or two years of college transfer credit.

The following courses are offered in conjunction with the above programs:

3.500	Seamanship I	4
3.502	Seamanship II	4
3.504	Seamanship III	4
3.510	Marine Electricity I	4
3.511	Marine Electricity II	4
3.800	Diesel Engines I	3
3.802	Diesel Engines II	3
	Diesel Engines III	3
	Engineering Maintenance	2
3.524	Boat Maintenance and Repair	3
4.165	Marine Welding I	3
4.166	Marine Welding II	3
	Marine Welding III	3
3.515	Marine Electronics	4
3.531	Marine Refrigeration I	3
	Marine Refrigeration II	3
3.530	Marine Food Preparation and Storage	2
3.321	Hydraulics and Pneumatics Systems I	3
	Hydraulics and Pneumatics Systems II	3
3.620	Navigation	3
4.300	Practical Physics I	4
4.302	Practical Physics II	4
3.521	Commercial Fishing Techniques I	4
3.522	Commercial Fishing Techniques II	4
3.523	Commercial Fishing Techniques III	4
3.525	Advanced Commercial Fishing IV	4
3.526	Economics of Commercial Fishing V	3
3.529	Advanced Commercial Fishing Techniques	4
3.668	Fishery Oceanography	--
5.212	Marine First Aid	4

The instructional staff for the courses listed above consists of the following:

Bronaugh, Dick L., Instructor
Hargis, Jackson B., Ed.D., Coordinator and Director of Vocational Training
Itzen, Eugene, M.S., Instructor
Muehlberg, Gary, M.S., Instructor
Nichols, Ward, Instructor
Phillips, George, M.B., Instructor
Roberts, Phillip, B.S., Instructor

To obtain further information, address all inquiries directly to:

Mr. Earl Craven
Dean of Students
Clatsop Community College
Astoria, Oregon 97103

CLEMSON UNIVERSITY
Clemson, South Carolina 29631

Clemson University offers programs in the College of Engineering, College of Physical, Mathematical and Biological Sciences, and the Belle W. Baruch Research Institute which is administered by the College of Forest and Recreation resources.

The College of Engineering maintains a large array of modern laboratory and field equipment for use in coastal engineering research and teaching activities. In addition, a 35-foot wave tank and an extensive hydraulic laboratory are available. The central university computer system is an IBM 370/155 with teleprocessing facilities. All students have access to small and medium sized analog computers. A large hybrid computer can be connected directly to research apparatus in the laboratory or in situ for immediate data treatment and display. Lake Hartwell, a 56,000-acre reservoir adjacent to the campus, provides a convenient opportunity to test equipment, theories and procedures.

The Belle W. Baruch Research Institute in Forestry, Wildlife Science and Marine Biology sponsors research and education programs in marine sciences. Current research involves dunes stabilization, spoils bank reclamation, flora and fauna of rice fields, fresh- and salt-water marshes and beaches, and management of maritime forests for optimum aesthetic and productive values. The institute manages 17,000 acres.

In addition to the facilities of the Belle W. Baruch Institute at Georgetown, S.C., Clemson University utilizes facilities at Morehead City, N.C. and Charleston, S.C. through cooperation with other institutions. On the main campus lecture and laboratory spaces in the areas of geology, zoology, microbiology, biochemistry and the engineering departments are available for teaching and research in marine science as well as ocean and coastal engineering.

Marine Resources Division of the South Carolina Wildlife and Marine Resources Department plans 5,826 square feet of laboratory and office space. These facilities will be jointly used with educational institutions including library, auditorium, wet laboratory, storage, lounge and canteen, research laboratories, teaching laboratories, offices, boats and boat storage, and the RV Dolphin owned and operated by this department. Clemson University will utilize a lecture-laboratory room primarily in the summer. Research space for graduate students and staff are used on an irregular basis.

Degrees relating to ocean engineering are offered within a particular degree granting department or program. The degrees of Master of Science and Master of Engineering are offered with the successful completion of 33 semester hours. Five students have graduated in the Civil Engineering Department and the Water Resources Program with an emphasis in ocean engineering within the last year. Formal degree programs in ocean and coastal engineering and marine biology are planned.

Courses offered in conjunction with the above programs include:

UNDERGRADUATE

Bot	446	Biological Oceanology	4
Bot	457	Phycology	3
ChE	452	Molecular and Turbulent Transport	3
CE	417	Airphoto Interpretation	3
CE	462	Port and Harbor Engineering	3
CE	490	Special Subjects	1-4
ECE	461	Analog Hybrid Computation and Simulation	3
Geol	403	Invertebrate Paleontology	3
Geol	313	Stratigraphy & Sedimentation	3
Geol	309	Petrology	3
Geol	408	Geohydrology	3
Geol	405	Geomorphology	4
MatE	450	Metallic Corrosion	3
ME	404	Physical Systems Analysis	3
WRE	460	Physical Oceanography	3
WRE	461	Oceanographical Engineering	3
Zool	201	Invertebrate Zoology	4
Zool	202	Vertebrate Zoology	4
Zool	403	Protozoology	3
Zool	408	Physiology & Development of Invertebrates	3
Zool	410	Limnology	3

Zool	411	Animal Ecology	3
Zool	463	Ichthyology	3
Zool	465	Ornithology	3

GRADUATE

BioE	680	Ecological Models	3
Bot	646	Biological Oceanology	4
Bot	657	Phycology	3
Bot	802	Mycology	4
ChE	652	Molecular and Turbulent Transport	3
ChE	803	Heat, Mass and Momentum Transfer	3
ChE	854	Environmental Instrumentation and Measurements	3
ChE	954	Environmental Systems Design	3
CE	617	Airphoto Interpretation I	3
CE	662	Port and Harbor Engineering	3
CE	831	Foundation Engineering	3
CE	902	Structural Vibration	3
ECE	661	Analog/Hybrid Computation and Simulation	3
ECE	815	Random Data Measurements and Analysis	3
ECE	827	Instrumentation and Measurements	3
ECE	850	Computation and Simulation	3
ESE	846	Pollution of the Aquatic Environment	3
ESE	862	Environmental Quality Case Study	3
FM	801	Foundation of Fluid Mechanics	3
FM	811	Experimental Fluid Mechanics	3
FM	812	Theory of Incompressible Ideal Flow	3
FM	815	Numerical Methods in Fluid Mechanics	3
FM	816	Flow in Open Channels	3
FM	901	Applied Hydrodynamics	3
Geol	603	Invertebrate Paleontology	3
Geol	613	Stratigraphy and Sedimentation	3
Geol	609	Petrology	3
Geol	800	Earth Science I	3
Geol	850	Earth Science II	3
Geol	608	Geohydrology	3
MatE	650	Metallic Corrosion	3
ME	604	Physical Systems Analysis	3
ME	844	Dynamics of Elastic Mechanical Systems	3
ME	860	Dynamic Programming	3
ME	882	Reliability Engineering	3
WRE	660	Physical Oceanography	3
WRE	661	Oceanographical Engineering	3
WRE	811	Climatology	3
WRE	812	Meteorology	3
WRE	876	Water Resources Systems	2
WRE	870	Stream and Estuarine Analysis	3
WRE	871	Coastal Hydrodynamics	3
WRE	872	Marine Pollution Control	2
Zool	603	Protozoology	3
Zool	608	Physiology & Development of Invertebrates	3
Zool	610	Limnology	3
Zool	611	Animal Ecology	3
Zool	633	Ichthyology	3
Zool	665	Ornithology	3

The instructional staff for the courses listed above consists of the following:

BIOCHEMISTRY

Shiveley, J. M., Ph.D., Associate Professor and Department Head

BOTANY

Dillon, C. R., Ph.D., Assistant Professor

CIVIL ENGINEERING

Edge, B. L., Ph.D., Associate Professor
Stafford, Donald B., Ph.D., Associate Professor

ELECTRICAL AND COMPUTER ENGINEERING

Drake, Thomas L., Ph.D., Associate Professor
Wolla, Maurice L., Ph.D., Associate Professor

ENGINEERING MECHANICS

Bauld, Nelson R., Ph.D., Professor
Zielinski, Paul B., Ph.D., Associate Professor

ENVIRONMENTAL SYSTEMS

Abernathy, A. Ray, Ph.D., Associate Professor
Andrews, John F., Ph.D., Professor and Head
Dysart, Benjamin C., III, Ph.D., Associate Professor
Keinath, Thomas M., Ph.D., Associate Professor

GEOLOGY

Birkhead, Paul K, Ph.D., Associate Professor
Griffin, Villard S., Jr., Ph.D., Associate Professor
Haselton, George M., Ph.D., Associate Professor
Hatcher, Robert D., Jr., Ph.D., Associate Professor
Snipes, David S., Ph.D., Assistant Professor

MATERIALS ENGINEERING

Hulbert, Samuel, Ph.D., Professor and Associate Dean
Wolf, James S., Ph.D., Associate Professor

MECHANICAL ENGINEERING

Coxe, Edwin F., Ph.D., Associate Professor

MICROBIOLOGY

Baxter, Ann W., Ph.D., Associate Professor
Guthrie, Rufus K., Ph.D., Associate Dean and Professor
Paynter, M. J. B., Ph.D., Associate Professor and Department Head

ZOOLOGY

Ingram, Byron R., Ph.D., Assistant Professor
Willard, William K., Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. A. E. Schwartz, Dean
Graduate Studies and University Research
Clemson University
Clemson, South Carolina 29631

COLUMBIA UNIVERSITY
New York, New York

Graduate students in marine sciences at Columbia University normally enroll in the Department of Geology, those in marine biology enroll in the Department of Biological Sciences. There is no separate Department of Oceanography. Students follow a program of study based on the varied courses offered within these departments. The major research facilities for the marine sciences (along with an extensive oceanographic library and computer facilities) are located at the Lamont-Doherty Geological Observatory campus of Columbus University in Palisades, New York. At Lamont, research is conducted in physical, chemical, geophysical and biological

oceanography as well as solid earth geophysics, geochemistry and meteorology.

The students have access to the material collected on numerous deep-sea expeditions by Lamont ships; among this data is the largest collection of deep-sea cores in the world. The Lamont-Doherty Observatory carries out oceanographic work aboard the 202-foot, 734-ton, 3-masted schooner, VEMA, and the 208-foot, 1370-ton AGOR-3, ROBERT D. CONRAD. In addition, polar oceanography programs are conducted using laboratories located on drifting ice stations in the Arctic Ocean.

The degrees of Master of Arts and Doctor of Philosophy are offered.

The following basic courses in marine sciences are offered by the Department of Geology. The exact curriculum to be followed by each student depends on his field of specialization and is decided upon by the student and his advisor. Other relevant courses are offered in the Departments of Physics, Chemistry, Biological Sciences and in the School of Engineering and Applied Science.

GEOLOGY DEPARTMENT

W4010	Chemical Geology II
W4928	Submarine Geology
W4941	Introduction to Geophysics
W4942	Survey of Geophysical Prospecting
W4927	Introduction to Oceanography
G6928	Advanced Submarine Geology
G4945	Geophysical Theory I
G4946	Geophysical Theory II
G6930	Dynamics of Ocean Currents
G9931	Physical Oceanography Seminar
W4226	Experimental Marine Sedimentology
G6223	Principles of Sedimentation
G6908	Analysis of Geophysical Data
G6681	Micropaleontology I: Principles and Foraminifera
G6682	Micropaleontology II: Radiolaria, Diatoms and Coccoliths
G9947	Marine Geophysics Seminar
G6944	Advanced Seismology I
G6949	Advanced Seismology II

The instructional staff for the courses listed above consists of the following:

Alsop, Leonard E., Adjunct Professor
Anderson, Orson L., Professor
Be, Allan W. H., Senior Research Associate, L-D.G.O.
Broecker, Wallace S. Professor
Donn, William L., Senior Research Associate, L-D.G.O.
Gast, Paul, Professor
Gordon, Arnold L., Assistant Professor
Hays, James D., Associate Professor
Heezen, B. C., Associate Professor
Hunkins, Kenneth L., Lecturer and Senior Research Associate, L-D.G.O.
Kuo, John T., Professor (Mining)
McCamy, Keith, Lecturer
Nafe, John E., Professor
Oliver, Jack E., Professor
Roels, Oswald, Senior Research Associate, L-D.G.O.
Sykes, Lynn, Associate Professor
Talwani, Manik, Professor/Interim Director

To obtain further information, address all inquiries directly to:

Chairman
Department of Geology
Columbia University
New York, New York 10027

UNIVERSITY OF CONNECTICUT
Storrs, Connecticut 06268

To conduct its research efforts, the Marine Sciences Institute has facilities at two locations on the Connecticut shore and operates three small research vessels at each site. The older of the two facilities is the Marine Research Laboratory at Noank, at the mouth of the Mystic River and about an hour from the main campus at Storrs; it has been operating since 1957 and specializes in biological research. This facility is a two-story brick building of some 7,000 square feet, housing laboratories, staff offices, a ship and biology library. The building features a continuous-flow salt-water system, a 1,500-gallon aquarium and conventional laboratory equipment for fisheries and biological research.

Adjoining the laboratory is a 125-foot long pier where the Noank fleet is docked, including a 65-foot converted T-boat, the U Conn, the 44-foot converted cabin cruiser, Ben Gunn, and a smaller 34-foot lobster boat, plus several skiffs and powered run-abouts. The larger boats are fully equipped to handle the various research tasks mentioned above.

A few minutes to the west of Noank is the Avery Point facility in Groton, located at the Southeastern Branch of the university where the Thames River meets the sea, opposite New London. At Avery Point, the institute has exclusive use of two large buildings, plus several smaller ones. The main building has approximately 17,000 square feet of floor space and has been renovated for oceanographic research and staff offices. The second building, with 34,000 square feet of space, is used for dry-laboratory work, teaching, machine fabrication and storage. The smaller buildings are used by the ships' crews as a place to repair oceanographic equipment and lay out equipment for cruises.

Some of the research equipment at Avery Point includes a ship-towed magnetometer, air-gun and sparker seismic sources, sonobuoys and receivers, current meters, a laboratory flume, a gas chromatograph, an X-ray diffraction unit, an underwater camera, sediment corers, rock dredges, earthquake seismometers, a machine and electronics shop, a 65-foot T-boat (the Navy owned T-441), a 40-foot research-converted cabin cruiser, the Sea Hoss, and a 36-foot cabin cruiser, the Hardly Ever, which is used both as a research platform and as a 15-knot shuttle to the institute's other ships at sea. The dock also shelters a Boston Whaler and a skiff.

The institute has its own IBM 2780 reader/printer remote computer terminal at Avery Point, which gives full access to the university's IBM 360/65 over leaded telephone lines.

The locations of the two facilities are well suited for the institute's several missions -- training graduate students, conducting research directly related to the marine environment, acting as an advisory or consulting body to the state and its various agencies, and offering credit extension courses to employees of the many maritime related industries that cluster around New London and Groton.

The teaching program is directed toward graduate training. Graduate and graduate-credit courses are offered in the marine sciences and related fields. These courses, which supplement the research program, are offered by departments so that M.S. and Ph.D. degrees can be earned in oceanography, biology, geophysics, geology or engineering. Formal courses are offered either at Storrs or at Avery Point, depending primarily on student convenience.

The following courses are offered in conjunction with the above programs:

ATMOSPHERIC SCIENCE

261	Climatology

BIOLOGY

236	Marine Microbiology
290	Introductory Phycology
292	Principles of Ecology
294	Marine Biology
395	Independent Study
396	Investigations of Special Topics
443	Marine Ecology
444	Marine Ichthyology
460	Advanced Phycology
461	Pathology of Invertebrates
445	Advanced Invertebrate Zoology

ENGINEERING

268	Limnology
269	Selected Environmental Problems
394	Water Pollution I
395	Water Pollution II

GEOLOGY

217	Sedimentation
221	Pleistocene and Glacial Geology
300	Stratigraphy
305	Special Problems in Geology
306	Advanced Mineralogy
307	Advanced Igneous and Metaphoria Petrology
314	Micropaleontology I
315	Micropaleontology II
330	Regional Structural Geology
333	Tectonophysics
340	Advanced Sedimentary Petrology
369	Submarine Geology and Geophysics

The instructional staff for the courses listed above consists of the following:

Bohlen, W. F., Ph. D., Assistant Professor of Physical Oceanography
Buck, J. D., Ph. D., Assistant Professor of Microbiology
Chiburis, E. F., Ph. D., Associate Professor of Geophysics
Dehlinger, P., Ph. D., Professor of Geophysics and Director of the Institute
Dowling, J. J., Ph. D., Associate Professor of Geophysics
Feng, S. Y., Ph. D., Associate Professor of Pathobiology
Fitzgerald, W. F., Ph. D., Assistant Professor of Chemical Oceanography
Garvine, R. W., Ph. D., Assistant Professor of Physical Oceanography
Libbey, A. J., Ph. D., Research Associate
Lund, W. A., Ph. D., Associate Professor of Ichthyology
Nalwalk, A. J., Ph. D., Associate Professor of Marine Geology
Paskausky, D. F., Ph. D., Assistant Professor of Physical Oceanography
Rankin, J. S., Jr., Ph. D., Professor of Biology and Director of the Marine Research Laboratory (Noank)

To obtain further information, address all inquiries directly to:

Dr. Peter Dehlinger, Director
Marine Sciences Institute
University of Connecticut
Avery Point
Groton, Connecticut 06340

CORNELL UNIVERSITY
Ithaca, New York 14850

An extensive, multidisciplinary program in aquatic studies exists at Cornell University. The program encompasses basic and applied stidues in the Colleges of Agriculture, Engineering and Arts and Sciences. A large number of offerings, scattered in various departments and schools on campus, are available to undergraduates.

At the graduate level, major and minor thesis areas are available in the following fields: botany (phycology); conservation (fishery science and aquatic resources); ecology and evolutionary biology (aquatic ecology, including limnology, marine ecology and oceanography; community and ecosystem ecology; paleoecology; vertebrate zoology, including herpetology and ichthyology); entomology and limnology (limnology); food science (aquatic microbiology); microbiology (aquatic microbiology); zoology (invertebrate zoology); biochemical engineering; environmental systems engineering; hydraulics-hydrology, and sanitary engineering.

The following courses are offered in conjunction with the above programs:

AGRONOMY

321	Soil and Water Conservation
415	Hydrometeorology
431	Aquatic Plants

BIOLOGICAL SCIENCES

344	Biology of the Algae
364	Introduction to Marine Science
460	Marine Ecology
461	Oceanography
462	Limnology
469	Biology of Fishes
470	Ichthyology
474	Herpetology
565	Special Topics in Limnology

CONSERVATION

439	Fish Ecology
440	Fishery Science
441	Fishery Resource Management
442	Basic Principles of Fish Culture
443	Ecological Aspects of Water Resources Management
600	Seminar: Major Fishery Investigations
601	Seminar on Selected Topics in Fishery Biology

ENTOMOLOGY AND LIMNOLOGY

471	Aquatic Entomology and Limnology
572	Advanced Limnology
672	Limnology and Entomology Seminar

FOOD SCIENCE AND TECHNOLOGY

412	Aquatic Microbiology

GEOLOGICAL SCIENCES

444	Geological Oceanography
532	Hydrogeology

RELATED COURSES

AGRICULTURAL ECONOMICS

450	Resource Economics

AGRONOMY

410 Microbial Ecology
413 Micrometeorology
550 Special Topics in Meteorology and Climatology

BIOLOGICAL SCIENCES

273 Biology of the Vertebrates
316 Invertebrate Zoology
361 General Ecology
479 Research in Ecology, Evolution and Systematics
572 Special Topics in Lower Vertebrates
665 Environmental Physiology
666 Population Ecology
667 Community Ecology
668 Ecosytems

CONSERVATION

304 Wildlife Ecology

GEOLOGICAL SCIENCES

421 Sedimentation
471 Invertebrate Paleontology

AGRICULTURAL ENGINEERING

321 Soil and Water Conservation
421 Introduction to Environmental Pollution
471 Soil and Water Engineering
506 Industrial Waste Management
603 Soils and Water Engineering Seminar

ENVIRONMENTAL ENGINEERING

2301 Fluid Mechanics
2318 Dynamic Oceanography
2320 Analytical Hydrology
2321 Flow Through Porous Media
2502 Environmental Quality - Analysis & Evaluation
2503 Water Quality Engineering
2510 Chemistry of Water & Waste Water
2513 Biological Phenomena & Processes
2515 Water Resource Problems & Policies
2518 Water Resource Systems
2531 Industrial Waste Management
2533 Environmental Quality Control
2547 Environmental Policy Analysis
2593 Water Resources Engineering

THERMAL ENGINEERING

3625 Heat Transfer
3642 Pollution Problems

CHEMICAL ENGINEERING

5312 New Separation Techniques
5748 Fermentation Engineering
5749 Industrial Microorganisms

The instructional staff for the courses listed above is as follows:

Alexander, M., Professor of Microbiology
Anderson, J. M., Professor of Invertebrate Zoology
Barlow, J. P., Professor of Marine Ecology and Oceanography
Berg, C. O., Professor of Limnology
Bloom, A. L., Professor of Oceanography
Carlson, C. A., Professor of Fishery Ecology
Dethier, E., Professor of Meteorology
Dondero, N. C., Professor of Microbiology
Eipper, A. W., Professor of Fishery Science
Evans, H. E., Professor of Fish Anatomy
Forney, J. L., Professor of Fishery Science
Gilbert, P. W., Professor of Ichtyology esp. Elasmobranchs
Hewitt, O. H., Professor of Aquatic Ornithology
Kingsbury, J. M., Professor of Phycology
Likens, G. E., Professor of Limnology
McFarland, W. N., Professor of Environmental Physiology
Oglesby, R. T., Professor of Aquatic Biology
Philbrick, S. S., Professor of Hydrogeology & Sedimentation
Pough, H., Professor of Environmental Physiology
Raney, E. C., Professor of Ichthyology
Robson, D. S., Professor of Fishery Statistics
Stone, E. L., Professor of Forest Soils
Webster, D. A., Professor of Fishery Science
Wells, J. W., Professor of Coral Ecology
Youngs, W. D., Research Associate of Fishery Science
Zwerman, P. J., Professor of Soil & Water Conservation

RELATED COURSES

Behn, V. C., Professor of Sanitary Engineering
Black, R., Professor of Water Engineering
Brutsaert, W., Professor of Hydrology
Dworsky, L. B., Professor of Water Resources Planning
Edwards, V., Professor of Biochemical Engineering
Finn, R., Professor of Biochemical Engineering
Gates, C. D., Professor of Water Quality Control
Gebhart, B., Professor of Transport Processes
Gouldin, F., Professor of Thermal Science
Lawrence, A. W., Professor of Water Quality Engineering
Levine, G., Professor of Water Engineering
Liggett, J. A., Professor of Oceanography
Loehr, R., Professor of Agricultural Wastes
Loucks, D. P., Professor of Environmental Systems Analysis
Lynn, W., Professor of Environmental Quality

UNIVERSITY OF DELAWARE
Newark, Delaware 19711

Facilities for marine research are located on the main campus in Newark and at the College of Marine Studies Field Station in Lewes, Delaware. Equipment and facilities available on the main campus support studies of shellfish culture, oyster pathology, salt marsh ecology, physiological ecology of marine organisms, marine pollution, coastal vegetation, benthic invertebrates, plankton, fishes, breakwater and cofferdam design, harbor construction, design and structural analysis of marine problems, dynamics of sediments in estuaries, coastal sedimentary processes, subsurface geographical mapping and organic chemistry.

Field station facilities encompass five sites involving more than 37,000 square feet of research and teaching space. The laboratories are accessible to a variety of marine habitats including the Atlantic Ocean, Delaware Bay and its tributaries, sand beaches, mud flats, salt marshes, rock jetties, sand dunes, and the full spectrum of estuarine conditions ranging from ocean to fresh waters. A variety of field and laboratory equipment for use in marine ecological studies is available including nets, dredges, bottom grabs, water samplers, coring devices, salinometers, fluorimeters, a fleet of small boats ranging in length from 10 to 17 feet, field vehicles, a 32-foot Chesapeake deadrise work boat, a 42-foot aluminum-hulled craft used for geophysical, geological, hydrographic and plankton studies, and a 48-foot wooden-hulled trawler designed for exploratory fishing with trawl and dredges, geological sampling, geophysical profiling and hydrographic work.

Within the next five years, a $3.8-million dollar campus of the College of Marine Studies will be constructed on 360 acres at Lewes.

Marine studies are conducted through graduate and undergraduate programs in the Departments of Biological Sciences, Civil Engineering and Geology. In 1970, the College of Marine Studies was established to focus these programs and to provide an academic center for exploration of the problems related to the development of Delaware's marine resources for multipurpose use. The college is a multi-disciplinary, graduate-level institution that provides an opportunity for study and research in marine biology, marine geology, ocean engineering, physical oceanography, chemical oceanography and marine affairs. Students may apply for undergraduate study in one of the university's departments listed as offering an undergraduate marine program. Graduate students may apply either to a university department that offers an advanced degree with a marine specialty or to the College of Marine Studies.

The following degrees are currently offered by the university:

DEPARTMENT OF BIOLOGICAL SCIENCES

Bachelor of Arts with option in marine biology. Requirements: at least 30 semester credits, including four biology courses, supplemented by courses in chemistry, mathematics and physics, one foreign language, and advanced undergraduate/graduate marine biology courses which may be taken as electives.

Master of Science (with specialization in marine biology). Students are accepted in the Ph. D. program of the Department of Biological Sciences. Those students who so desire may choose either thesis or non-thesis M.S. programs. The non-thesis program requires 30 hours of courses, three hours of research and the successful completion of four of the five areas of the departmental comprehensive examination. The thesis program requires 30 hours of course work and research credit culminating in a successfully defended thesis. Thesis programs for the M.S. degree are not encouraged.

Ph. D. Degree (with specialization in marine biology). Students in the Ph. D. programs are required to pass the departmental comprehensive examination which consists of writing a critical review essay of a selected, significant research paper in five areas. The predoctoral student must also pass an examination in his or her area of specialization and submit and defend an original research proposal; these are administered by the advisory committee. Experience in the teaching of undergraduates is required of all candidates for the Ph. D. degree. It is expected that a significant portion of the dissertation will be suitable for publication.

DEPARTMENT OF GEOGRAPHY

Bachelor of Arts. Students majoring in geography must complete a minimum of 30 credit hours in the department. While only three courses are required, it is expected that majors will take at least one course from each of the basic areas of geography taught at the university -- physical, economic, human, urban and cultural -- while concentrating more intensely in one or two of these areas.

Master of Arts or Master of Science. A master's degree program was begun in 1971. Depending on the area of specialization, the program, which requires 24 credit hours of courses in addition to a six-credit master's thesis, will lead to either an M.A. or an M.S. degree in geography. Class sizes are small, with considerable opportunity for the student to work directly with the faculty member in areas of mutual interest. The graduate program develops three major themes: environmental resource geography, urban geography and coastal and estuarine geography.

DEPARTMENT OF GEOLOGY

Bachelor of Science, with an emphasis in marine geology. Requirements: 30 credit hours in basic geology, 15 elective credits for additional geology, marine-oriented geology courses, and/or marine-oriented courses in related science disciplines. The B.S. also requires 24 credits of basic physics and chemistry and mathematics through calculus with a possible statistics option and one foreign language.

Master of Science in Geology. Requirements: 30 credit hours on the graduate level including thesis and an area of specialization within the many geologic subdisciplines. The M.S. degree may be specifically oriented to marine geology. A qualifying examination must be taken at least nine months before the date of anticipated graduation. Demonstrated ability to read scientific literature in one foreign language (french, german, russian). An oral examination is administered by the student's thesis committee after completion of the M.S thesis.

Ph. D. in Geology. The general requirements imposed by the University of Delaware include one year in residence. Oral and written qualifying examinations, in which the student demonstrates: the breadth and depth of his/her knowledge of the major geologic phenomena and processes, knowledge of the field of specialization (e.g., sedimentation-stratigraphy, marine geology, geochemistry) within the broader field of geology, knowledge of a minor field related to the area of specialization, a final oral examination and one foreign language (french, german or russian).

COLLEGE OF MARINE STUDIES

Master of Arts or Master of Science in Marine Studies. Students must satisfy the university requirement of 30 graduate credit hours. In addition to achieving a high level of competence in their area of specialization, they must demonstrate a broad understanding of the other five specialized fields in marine studies by successfully completing core course requirements. Beyond this, each student works out with his advisory committee a program of study that is tailored to his/her interests and may draw from departmental offerings throughout the university. The college distinguishes between the M.A. and M.S. degrees by the specialization that the graduate selected. If drawn heavily on parent disciplines in the humanities, he/she receives an M.A.; if on sciences, an M.S.

Ph. D. in Marine Studies. Each Ph.D. applicant must fulfill the university residence requirement of one continuous academic year. He/she must also satisfy the college core course requirements and pass written and oral qualifying examinations before formally being admitted to candidacy for the Ph. D. degree.

The following courses are offered in conjunction with the above programs:

BIOLOGICAL SCIENCES

B 627	Parasitology	4
B 630	Ichthyology	4
B 634	Invertebrate Zoology	4
B 639	Aquatic Microbial Ecology	3
B 666	Special Problem	1-6
B 866	Special Problem	1-6
B 867	Seminar	1
B 868	Research	1-9
B 969	Ph. D. Dissertation	1-12

GEOGRAPHY

G 220	Meteorology	3
B 320	Water Resources	3
G 655	Energy and Water Balance Climatology	3
G 660	Problems in the Marine Environment	3
G 855	Climatological Research	3

GEOLOGY

GEO 331	Geology of the World's Oceans	3
GEO 611	Quantitative Geomorphology	3

GEO 631	Marine Geology	3
GEO 632	Geology of Recent Sedimentary Environments	3
GEO 634	The Geology of Coasts	3
GEO 635	Introduction to Marine Sedimentology	1
GEO 636	Introduction to Marine Organic Sedimentology	1
GEO 637	Introduction to Marine Micropaleontology	1
GEO 638	Field Methods in Inorganic Geochemistry	1
GEO 639	Coastal Geohydrology	1
GEO 653	Elementary Geophysics I	3
GEO 655	Field Methods in Marine Geophysics	1
GEO 666	Special Problem	1-6
GEO 806	Micropaleontology	4
GEO 830	Geological Oceanography	3
GEO 831	Tectonics of the World's Ocean Basins	3
GEO 835	Marine Field Geology	1-6
GEO 853	Applied Seismology	3
GEO 866	Special Problem	1-6

MARINE STUDIES

CMS 200	A Nontechnical Introduction to Oceanography	3
CMS 600	Concepts in Physical Oceanography	3
CMS 615	Concepts in Biological Oceanography	3
CMS 627	Marine Botany	3
CMS 628	Marine Biology	6
CMS 629	Topics in Marine Ecology	3
CMS 631	Concepts in Marine Geology	3
CMS 645	Concepts in Chemical Oceanography	3
CMS 666	Special Problem	1-6
CMS 666	Special Problem: Aquatic Chemistry	1-6
CMS 666	Special Problem: Chemical Implications of Spacecraft Oceanography	2
CMS 666	Special Problem: Chemical Oceanography Field Course	2-4
CMS 670	Concepts in Marine Affairs	3
CMS 680	Concepts in Applied Ocean Science	3
CMS 681	Remote Sensing of the Environment	3
CMS 802	Physical Oceanography	3
CMS 805	Ocean Acoustics and Optics	3
CMS 808	Waves and Tides	3
CMS 809	Advanced Theoretical Oceanography	3
CMS 810	Estuarine Hydrodynamics	3
CMS 816	Biological Oceanography	4
CMS 828	Marine Invertebrates	4
CMS 866	Special Problem	1-6
CMS 866	Special Problem: Organic Compounds in Sea Water	3
CMS 867	Seminar	1
CMS 868	Research	
CMS 869	Master's Thesis	1-6
CMS 969	Ph. D. Dissertation	1-6

The instructional staff for the courses listed above consists of the following:

COLLEGE OF MARINE STUDIES

Thirty-two faculty members hold appointments in the College of Marine Studies. Many of these hold joint appointments with other departments within the university (noted in parenthesis).

Biggs, Robert B., Ph. D., Assistant Professor and Assistant Dean (Geology)
Born, John, Ph. D., Assistant Professor (Biological Sciences)
Camfield, Frederick E., Ph. D., Assistant Professor (Civil Engineering)
Church, Thomas M., Ph. D., Assistant Professor (Chemistry)
Costello, Frederick A., Ph. D., Associate Professor (Mechanical and Aerospace Engineering)
Daiber, Franklin C., Ph. D., Professor (Biological Sciences)
Ditmars, John D., Ph. D., Assistant Professor (Civil Engineering)
Epifanio, Charles E., Ph. D., Assistant Professor
Gaither, William S., Ph. D., Professor and Dean
Glass, Billy P., Ph. D., Assistant Professor (Geology)
Jordan, Robert R., Ph. D., Associate Professor (Geology)
Klemas, Vytautas, Ph. D., Associate Professor (Geography)
Kraft, John C., Ph. D., Professor (Chairman of Geology)
Kupferman, Stuart L., Ph. D., Assistant Professor
Lotrich, Victor A., Ph. D., Assistant Professor (Biological Sciences)
Mangone, Gerard J., Ph. D. Professor (Political Science)
Mather, John R., Ph. D., Professor (Chairman of Geography)
Maurer, Donald L., Ph. D., Associate Professor (Biological Sciences)
Merrill, James M., Ph. D., Professor (History)
Myers, Thomas D., Ph. D., Assistant Professor (Biological Sciences)
Polis, Dennis F., Ph. D., Assistant Professor
Price, Kent S., Ph. D., Associate Professor and Associate Dean (Biological Sciences)
Sheridan, Robert E., Ph. D., Assistant Professor (Geology)
Somers, G. Fred, Ph. D., Professor (Biological Sciences)
Swain, Frederick M., Ph. D., Professor (Geology)
Szekielda, Karl-Heinz, Ph. D., Assistant Professor (Chemistry)
Taylor, Jonathan E., Ph. D., Assistant Professor (Biological Sciences)
Trumbore, Conrad N., Ph. D., Associate Professor (Chemistry)
Vinson, Jack R., Ph. D., Professor (Chairman of Mechanical and Aerospace Engineering)
Wang, Hsiang, Ph. D., Associate Professor (Civil Engineering)
Wood, Robert H., Ph. D., Professor (Chemistry)
Yang, Cheng Y., Ph. D., Professor (Civil Engineering)

DEPARTMENT OF BIOLOGICAL SCIENCES

Shane, Miriam S., M. S., Associate Professor
Tripp, Marenes R., Ph. D., Professor

DEPARTMENT OF GEOGRAPHY

Swaye, F. J., M. A., Instructor

To obtain further information, address all inquiries directly to:

Dr. Robert B. Biggs, Assistant Dean
College of Marine Studies
University of Delaware
Newark, Delaware 19711

Ocean engineering courses are offered both at the main campus in Newark and at the College of Marine Studies Field Station in Lewes. On-campus laboratory facilities are located primarily within the Departments of Civil and Mechanical and Aerospace Engineering. The fluid mechanics laboratory contains a combined towing and wave tank with eight-foot by five-foot test section, a 90-foot long wave tank, a free surface hydrodynamic tank with a four-foot by six-foot test section, a rotating flow table and a ripple tank. A number of oceanic research vessels and a 50-foot by 50-foot wave basin are frequently used facilities at Lewes.

The environmental engineering laboratories are equipped for chemical and biological analyses of water. Specialized equipment includes stability indicator, turbidimeter, BOD apparatus, Kjeldahl N apparatus, spectrophotometer, polargraph, rotary viscomoter, Warburg respirator, CHN analyzer, and a D.O. probe accurate to one part per billion of dissolved oxygen.

Well-equipped soil mechanics, metallurgical and structural laboratories are also available for marine-oriented research. Field research and instruction in coastal and oceanographic engineering are conducted at the Lewes campus using classrooms, laboratories and vessels located there.

Ocean engineering is an interdisciplinary program sponsored on an interdepartmental basis through either the College of Engineering or the College of Marine Studies. Both undergraduate and graduate programs are available through the College of Engineering, while the College of Marine Studies offers graduate programs only. Students interested in graduate work may apply either to the College of Engineering, where they may earn a Master of Civil Engineering or a Ph.D. in Applied Science; or to the College of Marine Studies, where they may earn a Master of Science in Marine Studies or a Ph.D. in Marine Studies, both with an emphasis in ocean engineering.

The university offers the following degrees:

Bachelor of Civil Engineering - with specialization in ocean engineering (Department of Civil Engineering). All students are required to complete the basic civil engineering curriculum requiring 124 semester hours of course credit. This allows 18-22 hours of technical electives which may be devoted to marine-related courses or special projects. Similar B.S. degree programs exist in Chemical Engineering, Electrical Engineering and Mechanical and Aerospace Engineering.

Master of Civil Engineering - with specialization in ocean engineering. This program requires that a student complete 30 credit hours of graduate study beyond the bachelor's degree of which 24 are in course work plus six hours of thesis. Thesis-less M.S. is also available. Considerable flexibility is available to permit a student to formulate a program suited to specific interests. Similar programs exist in the other engineering departments.

Ph.D. in Applied Science - with specialization in ocean engineering. Essentially 72 semester credits beyond the bachelor's degree are required including approximately 24 credits in the major area, 24 credits in the areas of mathematics, physical and engineering science and 24 credits in thesis research.

The following courses are offered in conjunction with the above program:

CIVIL ENGINEERING

CE	671	Ocean Engineering I	3
CE	672	Ocean Engineering II	3
CE	673	Engineering in a Coastal Environment	3
CE	674	Coastal and Estuarine Geotechnique	3
CE	675	Marine Soils Engineering	3
CE	837	Mechanics of Free Surface Flow	3
CE	839	Applied Hydraulics	3
CE	866	Special Problems	1-6
CE	866	Hydrologic Transport Phenomenon	3
CE	871	Marine Structures I (Floating)	3
CE	872	Marine Structures II (Fixed)	3
CE	873	Marine Transportation Systems	3

GEOGRAPHY

G	220	Meteorology	3

GEOLOGY

GEO	631	Marine Geology	3
GEO	637	Geology of Recent Sedimentary Environments	3

MECHANICAL AND AEROSPACE ENGINEERING

MAE	622	Introduction to Stability and Control	3
MAE	633	Hydromechanics	3
MAE	833	Fluid Mechanic Stability	3
MAE	611	Principles of Continuum Mechanics	3

MATERIALS AND METALLURGY

MET	611	Corrosion and Corrosion Control	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL ENGINEERING

Camfield, Frederick E., Ph.D., Assistant Professor
Ditmars, John D., Ph.D., Assistant Professor
Preslan, William L., B.S., Instructor
Wang, Hsiang, Ph.D., Associate Professor
Yang, Cheng Y., Ph.D., Professor

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Greenberg, Michael D., Ph.D., Assistant Professor
Costello, Frederick A., Ph.D., Associate Professor
Vinson, Jack R., Ph.D., Professor

COLLEGE OF MARINE STUDIES

Gaither, William S., Ph.D., Professor and Dean
Klemas, Vytautas, Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Hsiang Wang
College of Engineering
University of Delaware
Newark, Delaware 19711

DEL MAR COLLEGE
Corpus Christi, Texas 78404

The college offers a curriculum in marine science-electronics technology including the freshman and sophomore years. The program is primarily designed to produce technicians trained to work in marine-related professions after two years, although transfer to a senior institution is possible. The curriculum was originated in 1969 and has been revised several times to make it more compatible with current needs. The college has a marine instrumentation laboratory, complete with all water quality measuring instruments, and a large artificial wave tank. Training for freshmen students includes use of the 24-foot training vessel T/V Del Marco; sophomore students work in conjunction with the Ocean Science and Engineering Laboratory of Southwest Research Institute and use the 65-foot research vessel R/V Southwest Researcher.

The Associate in Applied Science degree is offered by the Department of Engineering Technology. The degree requires a minimum of 66 hours, which are distributed as indicated.

Marine Science Technology	31
Mathematics	6
English	6
Government	3
Electronics Engineering Technology	16
Analytical Instruments	4

UNDERGRADUATE COURSES

MARINE SCIENCE TECHNOLOGY

301	Introduction to the Marine Environment	3
302	Chemical Oceanography	3
405	Marine Geology	4
310	Underwater Acoustics	3
410	Marine Biology	4
216	Seminar	2
403a	Marine Laboratory--one	2
403b	Marine Laboratory--two	2
414	Marine Science Instrumentation	4
413	Marine Science Problems	4

The instructional staff consists of the following:

O'Donnell, Jerry F., Ph.D., Assistant Professor of Engineering Technology, Department of Engineering Technology
Thorpe, Mary S., M.S., Instructor of Geology, Department of Geology
White, John M., Ph.D., Professor of Biology, Department of Biology

Because of limited facilities, registration is limited. Students will be selected on the basis of interest and aptitude and on proven ability in mathematics. Selection of fall registrants is done in May. For further information, address inquiries directly to:

Dr. Jerry F. O'Donnell
Project Director, Marine Science
Del Mar College
Corpus Christi, Texas 78404

DOWLING COLLEGE
Oakdale, New York 11769

The Dowling College Marine Science Program is an interdisciplinary study combining knowledge and techniques of biology, chemistry, geology, mathematics, meteorology and physics. Students exploring the marine sciences take advantage of the college's location on the Connetquot River and its proximity to the Great South Bay in their research on coastal and estuarine processes. The Adelphi University Institute for Marine Sciences, located on the Dowling campus, provides the possibility for joint research and teaching activities.

The physical facilities include well-equipped laboratories, walk-in cold rooms, the Suffolk, a 24-foot fiberglas craft equipped with radio-telephone and recording fathometer, winch and boom, an 18-foot rubber dive boat, an 11-foot fiberglas skiff, a 300-gallon recirculating salt water aquarium, boat ramp and a recording weather station. Students operate an extensive inventory of sampling equipment and become acquainted with safe diving procedures. A diving course is planned for the near future. Samples are classified and analyzed in well-equipped laboratories which include the following equipment: gas chromatography, atomic absorption, UV and IR spectrophotometry. Cooperation with the aeronautics department provides the opportunity for aerial observation of the marine environment.

An innovative seminar/research course is offered each January at the Lerner Marine Laboratory on the island of Bimini in cooperation with Boston, Brandeis, Tufts, and the American Museum of Natural History. A five-week pre-undergraduate preparation course is offered to high school students and carries one-half year high school credit. Students participating in the multidisciplinary marine science program receive the B.A. or B.S. degree in biology or natural science with emphasis in marine science.

The following courses are offered in conjunction with the above program:

BIOLOGY

Bio 12	Biology of Invertebrates	5
Bio 16	Microbiology	5
Bio 18	Tropical Marine Biology	3
Bio 37	Marine Botany	5
Bio 56	Marine Biology	5
Bio 191, 192	Special Problems	1-3

CHEMISTRY

Chem 36	Instrumental Analysis	5

NATURAL SCIENCE

NS 52	Elements of Oceanography	5
NS 191, 192	Special Problems	1-3

PHYSICS

Physics 4	Meteorology	4

The instructional staff for the courses listed above consists of the following:

Brown, Robert Z., Sc.D., Professor
Gschwendtner, John v.G., Ph.D., Professor
Moeller, Henry W., Ph.D., Assistant Professor
Smith, Major R., M.A., Assistant Professor
Spingola, Frank, Ph.D., Assistant Professor
Wiegand, Steven G., B.S., Administrative Assistant

To obtain further information, address all inquiries directly to:

Dr. Henry W. Moeller, Coordinator, Biology Dept.
Dowling College
Idle Hour Boulevard
Oakdale, New York 11769

DUKE UNIVERSITY
Durham, North Carolina 27706

The Duke University Marine Laboratory (DUML) at Beaufort, North Carolina, is an interdepartmental and interuniversity facility for training and research in the marine sciences. It is open throughout the year with an academic and technical staff in residence. It presently occupies 15 acres on the southern portion of Pivers Island near Beaufort. The National Oceanic and Atmospheric Administration laboratory encompasses the remainder of the island. The present plant consists of 19 buildings, includ-

ing four dormitories capable of housing 72 people, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories and four single air-conditioned research laboratories plus one recently completed, three-story, year-round research facility.

The station operates a well-equipped 118-foot research vessel Eastward for training and research in oceanography, a 55-foot trawler for offshore investigations, and a 39-foot cabin powerboat for trawling and dredging in surrounding sounds and estuaries. A 22-foot "Harkers Island inboard" is equipped for trawling and dredging in shallow waters of the sounds. Also available are rowboats with outboard motors and collecting gear, including dredges, bottom grabs, water samplers, coring devices, salinometers and fluorometers. The DUML library receives 125 current periodicals and is complemented by the added holdings of the NOAA library and the library of the University of North Carolina Institute of Marine Sciences, located in the Beaufort-Morehead City area. The completion of a library-auditorium will provide seating capacity for 280 people plus smaller conference rooms, stack area and reading room.

Separate degrees are not offered in the marine sciences, but a student may pursue work for the A.M. and Ph.D. degrees in biochemistry, botany, chemistry, physiology and zoology. For the A.M. degree in geology, course work may be taken and a thesis written in marine geology or geological oceanography. A B.S. in geology is offered with a curriculum preparatory to advanced studies in oceanography.

In botany, the student's graduate program is planned to provide broad basic training in various fields of botany, plus intensive specialization in the field of the research problem. Graduate courses in the Department of Geology are designed to provide training in the field of sedimentary geology and micropaleontology. Areas of specialization in thesis research include continental shelf sedimentation, deep-sea sedimentation, micropaleontology of deep sea sediments and carbonate sedimentation.

Required work for the A.M. degree in zoology ordinarily includes 12 units of advanced course work in zoology, six units of course work in a minor department and an additional six units of advanced work in a major or minor department or in other pertinent departments. Furthermore, an acceptable thesis is necessary for the fulfillment of the degree requirements.

Normally the degree program for the Ph.D. degree includes graduate courses in several fields of zoology, courses in the minor subject, wide reading in science in general and in biology in particular, research, and a dissertation based on original work. Minor work is available in many related fields, including anatomy, biochemistry, botany, chemistry, geology, physics, physiology, and engineering.

A graduate student working for the Ph.D. degree usually takes course work on the main Durham campus in that particular department during the academic year and then goes to the marine laboratory for more specialized courses during the summer. By the end of the second year, he or she is expected to have passed an oral preliminary examination in his department. Thereafter, the student is free to do thesis research without further course requirements on the Durham and/or the DUML campus.

Training in the marine sciences at Duke University and at the Duke University Marine Laboratory is at the senior-graduate level in the Departments of Botany, Geology and Zoology, with the exception of the undergraduate spring term in the marine sciences which accepts students who have completed the sophomore requirements. Students are free to elect courses in any of the science departments including those in the School of Medicine and Engineering. Research and courses exist in the School of Engineering in the areas of communication theory, stochastic information processing, decision theory, digital computer systems, ocean structures and coastal formations. The undergraduate spring term provides students at the junior or senior level to spend an entire spring term at the marine laboratory, taking two courses, one seminar and one independent research program supervised by one of the resident staff.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

104	Man and the Marine Environment	1
169	The Marine Environment	1
150L	Physiology of Marine Organisms	1
296S	Seminar	0.5
	Independent Study	1.5

BOTANY

SENIOR-GRADUATE

205	Marine Microbiology	6
207	Marine Mycology	6
211	Marine Phycology	6
220	Coastal Field Botany	6
225	Special Problems	3
226	Special Problems	3
255	Plant Systematics	4
259	The Environment - Seminar	4

GRADUATE

359	Research in Botany
360	Research in Botany

BIOCHEMISTRY

SENIOR-GRADUATE

276	Comparative and Evolutionary Biochemistry	6

GEOLOGY

SENIOR-GRADUATE

205	Geological Oceanography	6
206	Principles of Geological Oceanography	3
208	Shallow-Marine Geology	3
213	Sedimentology	3
214	Sediments in Thin Section	3
222	Sedimentary Minerals	3
243	Micropaleontology	3
244	Micropaleontology	3
247	Paleoecology	3

GRADUATE

300	Seminar in Oceanography
312	Seminar in Sedimentology

PHYSIOLOGY

GRADUATE

M394	Marine Membrane Physiology	6

ZOOLOGY

SENIOR-GRADUATE

202	Introduction to Comparative Behavior	6
203	Marine Ecology	6
214	Biological Oceanography	6
216	Limnology	3-4
238	Systematic Zoology	4
240	Chemical Oceanography	6
250	Physiological Ecology of Marine Animals	6
274	Marine Invertebrate Zoology	6
276	Comparative and Evolutionary Biochemistry	6
277	Endocrinology of Marine Animals	6
278	Invertebrate Embryology	4-6

GRADUATE

351	Departmental Seminar

352 Departmental Seminar
353 Research
354 Research
355 Seminar
356 Seminar
Advanced Oceanographic Seminar

The instructional staff for the courses listed above consists of the following:

BIOCHEMISTRY DEPARTMENT

Sullivan, James B., III., Ph. D., Assistant Professor

BOTANY DEPARTMENT

Barber, Richard T., Ph. D., Associate Professor of Botany and Zoology, Marine Ecology
Billings, William D., Ph. D., James B. Duke Professor of Botany, Plant Ecology
Blankley, William, Ph. D., Assistant Professor of Botany and Phytoplankton Systematics
Johnson, Terry W., Ph. D., Professor of Botany, Marine Mycology
Searles, Richard B., Ph. D., Associate Professor of Botany, Marine Phycology
Wilbur, Robert L., Ph. D., Chairman and Professor of Botany, Plant Systematics

GEOLOGY DEPARTMENT

Heron, Stephen D., Ph. D., Chairman and Associate Professor of Geology, Sedimentary Petrology
Lynts, George W., Ph. D., Assistant Professor of Geology, Micropalentology
Perkins, Ronald, Ph. D., Associate Professor of Geology, Sedimentology
Pilkey, Orrin H., Ph. D., Associate Professor of Geology, Marine Geology

PHYSIOLOGY DEPARTMENT

Gutknecht, John, Ph. D., Assistant Professor

ZOOLOGY DEPARTMENT

Bailey, Joseph R., Ph. D., Professor of Zoology, Vertebrate and Systematic Zoology
Barber, Richard T., Ph. D., Associate Professor of Botany and Zoology, Marine Ecology
Bookhout, Cazlyn G., Ph. D., Professor of Zoology, Invertebrate Embryology and Zoology
Costlow, John D., Jr., Ph. D., Professor of Zoology and Director of Duke University Marine Laboratory, Invertebrate Embryology and Zoology
Forward, Richard, Ph. D., Assistant Professor of Zoology, Physiological Ecology
Fluke, Donald J., Ph. D., Chairman and Professor of Zoology, Biophysics
Gray, Irving E., Ph. D., Professor of Zoology (ret.), Ecology
Livingstone, Daniel A., Ph. D., Professor of Zoology, Limnology
Lundberg, John G., Ph. D., Assistant Professor of Zoology, Vertebrate and Systematic Zoology
Sutherland, John P., Ph. D., Assistant Professor of Zoology, Marine Ecology
Wainwright, Stephen A., Ph. D., Associate Professor of Zoology, Invertebrate Zoology
Wilbur, Karl M., James B. Duke Professor of Zoology, Cellular Physiology

CIVIL ENGINEERING DEPARTMENT

Muga, Bruce J., Ph. D., Associate Professor

ELECTRICAL ENGINEERING DEPARTMENT

Nolte, Loren W., Ph. D., Associate Professor

MECHANICAL ENGINEERING DEPARTMENT

Linderoth, L. Sigfred, Jr., M. E., Professor

To obtain further information, address all inquiries directly to:

Director of graduate studies of the department of particular interest, or:

Dean of the Graduate School
Duke University
Durham, North Carolina 27706

EAST CAROLINA UNIVERSITY
Greenville, North Carolina

The marine science program at East Carolina University, Greenville, North Carolina, offers a marine orientation to biology and geology majors. No degree in marine science is available at this time. Courses in ecology field botany, ichthyology, invertebrate zoology, sedimentation, and field methods have been adapted to a marine and estuarine orientation. A basic course in oceanography and directed studies for individual research experience complete the existing program which is conducted during the fall and spring quarters at the Coastal Resources Center, Manteo, North Carolina.

The marine science activities of the Coastal Resources Center are entering into a three-level program of development. Level I will be interdisciplinary and directed toward the sophomore and junior years. It will form an initial introduction to coastal processes and man's involvement in them. Archeology, biology, geography and geology will have major input into this program. The introductory interdisciplinary program is scheduled for fall of 1973. Level II is structured to give the student intensive instruction, field work, and professional orientation in a chosen discipline and is directed toward the upper undergraduate. Level III will provide research and reporting experience through individual research and directed studies. This level will be directed toward the seniors and graduate students.

UNDERGRADUATE COURSES

Department of Biology

BIO	132	Field Botany	4
BIO	181	Biology of the Invertebrates	4
BIO	313		
	a, b, c	Research Problems in Biology	3
BIO	325	Ecology	4
BIO	355	General Ichthyology	5

Department of Geology

GEO	225	Oceanography	3
GEO	304	Sedimentation	4
GEO	340	Directed Studies	1-3
GEO	341	Directed Studies	1-3

The instructional staff for the courses listed above consists of the following:

Department of Biology

Bellis, Vincent J., Ph. D., Associate Professor
O'Rear, Charles W., Jr., Ph. D., Assistant Professor
Ryan, Edward P., Ph. D., Associate Professor

Department of Geology

O'Connor, Michael P., Ph. D., Associate Professor
Riggs, Stanley R., Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

James A. McGee, Director
Coastal Resources Center
Box 2727
East Carolina University
Greenville, North Carolina 27834

UNIVERSITY OF FLORIDA
Gainesville, Florida 32601

The university is involved in a broad array of marine-related activities beyond formal curricula. The specialized facilities discussed below are directly used in education. For the most part, the University of Florida's curricula in the marine sciences are formally established at the graduate level, wherein a student conducts research and is permitted broad flexibility in course work.

Off-campus facilities operated by the Division of Biological Sciences include laboratories on both the Gulf of Mexico and the Atlantic Ocean. The Sea Horse Key Marine Laboratory is located 57 miles west of Gainesville on the Gulf Coast, three miles offshore, opposite Cedar Key. Living accommodations are provided in a 10-room lighthouse and a 20 by 40-foot laboratory building, complete with running sea water is available for research use. The marine laboratory owns a 32-foot research vessel equipped for offshore work and a number of smaller boats for inshore and shallow water use. A dock and marine railway are situated next to the laboratory. The location at Sea Horse Key provides ease of access to diverse habitats ranging from freshwater rivers, estuaries and salt marshes to the marine water of the Gulf of Mexico. Clark Island and the surrounding waters, amounting to 41 acres, located near Sea Horse Key belong to the University of Florida. This undisturbed area is available for use in intensive studies of estuarine resources and processes.

The university's marine activities on the Atlantic coast of Florida have largely been centered at Marineland, Inc., in Flagler County. The commitment by Marineland to provide available land and cooperate with the university in erecting a marine science laboratory building as well as classrooms and a dormitory is now in the construction stage.

The Communication Sciences Laboratory is located in the Department of Speech. Created in 1965, the laboratory has a full-time faculty of 18 and is devoting considerable effort to underwater speech communication. This work is supported by the U.S. Navy and utilizes six Navy laboratories including their research station at Bugg Springs in the central portion of the state.

The Florida State Museum serves as a center for research in anthropology and natural history. Strongly oriented toward basic research, it carries a dual responsibility as both the state and university museum. Of particular interest to the aquatic sciences are the collections of reptiles, amphibians, fishes and molluscs. Completion of new museum facilities on the campus adjacent to the life sciences building complex has afforded a greatly increased opportunity for research, interpretive displays and an even greater level of cooperation with other units of the university. The new facility includes aquarium rooms which will be of value to many areas of the aquatic, estuarine and marine sciences.

Since formation of the Coastal Engineering Laboratory, 40 major investigations of Florida locations have been made where erosion and other problems exist. Over 1,200 reports on erosion, coastal protection, navigation, bay fill, and other bay problems have been submitted to state agencies. Other important fields of research deal with sediment transport by waves and currents, sand transport by wind, air-sea interaction, the tracings of littoral drift using fluorescent traces, problems of beach protection, and other coastal protective measures. Present facilities include a wind and wave facility, model slabs, 50-foot wave generator, smaller wave generators, wind tunnels, automatic tide level generator, and various special instruments.

The following graduate degrees are offered (and the number of degrees awarded last year in parenthesis):

1. Master of Science (3) and Ph. D. (1) in Botany. Requirements include core undergraduate courses and recommendations of the supervisory committee.

2. Engineer (0), Master of Engineering (4) and Master of Science in Engineering (0) in Civil and Coastal Engineering. Course requirement is a program recommended by the supervisory committee.

3. Master of Engineering (27), Master of Science (24), Engineer (0) and Ph. D. (4) in Environmental Engineering Sciences. Required is a bachelor's engineering or science background or articulation work.

4. Master of Science in Geology (8). Required are the core undergraduate courses and a recommended summer field course.

5. Master of Science (4) and Ph. D. (5) in Zoology. Requirements are the core curriculum and recommendations of the supervisory committee based on written examinations.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

AE 322	Special Studies in Architecture - Southwest Florida Planning Team	4
BTY 301	Introduction to Ecology	4
BTY 342	Local Flora	3
BTY 501	Plant Ecology	5
BTY 521	Introductory Mycology	5
BTY 522	Phycology	5
COE 400	Introduction to Coastal and Oceanographic Engineering	3
COE 410	Coastal Hydraulics	3
COE 550	Harbor Engineering	4
COE 560	Ocean Engineering	4
ENE 301	Environmental Quality and Man	4
ENE 513	Introduction to Environmental Resource Systems	4
ENE 520	Environmental Biology	4
ES 331	Principles of Resource Utilization	4
ES 400	Senior Seminar in Environmental Economics	3
FRE 332	Economics of Environmental Quality	4
FRE 530	Natural Resource Utilization	4
FY 250	The Ecosystem: Man-Resource Relationships	4
GPY 331	Conservation of Resources	4
GY 424	Marine Mollusca of Florida	4
GY 470	Introductory Oceanography	4
GY 501	Geomorphology	4
GY 508	Geochemistry	4
GY 517	Marine Geology	4
GY 560	Sedimentology	4
MCY 302	Basic Biology of Microbiology	5
MCY 507	Microbial Ecology	5
MCY 519-521	Microbial Chemistry	5
ME 530	Marine Systems	3
ME 531	Marine Systems	3
MTY 446	Passive Remote Sensing	3
MTY 447	Active Remote Sensing	3
PCL 552	Politics of the Environment	5
ZY 308	Invertebrate Zoology	5
ZY 505	General Ecology	5
ZY 579	The Biology of Marine Animals	4

GRADUATE

BTY 601	Vegetation of Florida	5
BTY 602	Ecology of Aquatic Plants	5
COE 610	Ocean Waves 1: Linear Theory	4
COE 611	Ocean Waves 2: Nonlinear Theory	4
COE 612	Ocean Wave Spectra	4
COE 613	Estuarial Hydromechanics and Engineering 1	4
COE 614	Estuarial Hydromechanics and Engineering 2	4
COE 615	Estuarial Hydromechanics and Engineering 3	4
COE 620	Coastal Structures 1	4
COE 621	Coastal Structures 2	4
COE 630	Littoral Processes	4
COE 631	Simulation Techniques	4
COE 632	Selected Field and Laboratory Problems	3-8
COE 640	Physical Oceanography	4
COE 641	Air-Sea Interaction 1: Microscale	4
COE 642	Air-Sea Interaction 2: Macroscale	4
COE 643	Advanced Topics in Coastal and Oceanographic Engineering	1-6
ENE 611	Water Quality Management	3
ENE 612	Water Quality Seminar	0-5
ENE 613	Environmental Resource Systems	4
ENE 614	Advanced Water Surply Engineering	4
ENE 616	Urban Environmental Problems	4
ENE 617	Estuarine Systems	4
ENE 618	Pollution Transport Systems	4
ENE 626	Aquatic Microbiology	4
ENE 627	Biology of Aquatic Systems	4
ENE 630	Environmental Chemistry	5
ENE 631	Advanced Water Analysis	4
ENE 636	Principles of Water Chemistry	5
ENE 640	Radiological Health	3
ENE 641	Radiological Techniques	5
ENE 642	Radioactive Wastes	4
ENE 643	Electronic Product Radiation	4
ENE 650	Occupational Health	4
ENE 651	Atmospheric Pollution	3
ENE 652	Environmental Instrumentation	5
ENE 654	Air Pollution Sampling and Analysis	4
ENE 655	Air Pollution Control Measures	4
ENE 656	Environmental Meteorology	4
ENE 657	Environmental Micrometeorology	4
ENE 660	Ecological and General Systems	4
FRE 630	Natural Resource Economics	4
GPY 635	Land and Water Utilization	5
GY 601	Geomorphology of Southeastern United States	4
GY 611	Mineralogy of Clays	4
GY 624	Paleoecology	4
GY 664	Fluvial, Deltaic and Transitional Environments of Sedimentation	4
GY 668	Coastal and Estuarine Geology	4
GY 675	Geological Oceanography I	4
LW 643	Natural Resources	4
LW 684	Seminar (Water Law)	4
LW 695	Selected Legal Problems	4
ZY 605	Tropical Biology	12
ZY 609	Zoogeography	3
ZY 610	Advanced Tropical Zoology	12
ZY 612	Marine Ecology	5
ZY 626	Community Ecology	5
ZY 651	Ichthyology	5

The instructional staff for the courses listed above includes the following:

BOTANY

Aldrich, H.C., Ph.D., Assistant Professor
Anthony, D.S., Ph.D., Associate Professor
Davis, J.S., Ph.D., Associate Professor
Fritz, G.J., Ph.D., Associate Professor
Griffin, D.G. III, Ph.D., Assistant Professor
Griffith, M.M., Ph.D., Professor
Humphreys, T.E., Ph.D., Professor
Kimbrough, J.W., Ph.D., Associate Professor
Lugo, A.E., Ph.D., Assistant Professor
Mullins, J.T., Ph.D., Associate Professor
Shanor, L., Ph.D., Professor
Smith, R.C., Ph.D., Assistant Professor
Stanley, R.G., Ph.D., Professor
Vasil, I.K., Ph.D., Associate Professor
Ward, D.B., Ph.D., Associate Professor

COASTAL ENGINEERING

Dean, R.G., D.Sc., Professor
O'Brien, M.P., B.S., Professor
Partheniades, E., Ph.D., Professor
Purpura, J.A., M.S.E., Associate Professor
Shemdin, O.H., Ph.D., Associate Professor

ENVIRONMENTAL ENGINEERING

Bevis, H.A., Ph.D., Associate Professor
Bolch, W.E., Jr., Ph.D., Associate Professor
Brezonik, P.L., Ph.D., Associate Professor
Dunavant, B.G., Ph.D., Associate Professor
Fox, J.L., Ph.D., Assistant Professor
Furman, T. DeS., M.S.C.E., Professor
Heaney, J.P., Ph.D., Assistant Professor
Huber, W.C., Ph.D., Assistant Professor
Mauderli, W., D.Sc., Professor
Morgan, W.H., Ph.D., Associate Professor
Odum, H.T., Ph.D., Graduate Research Professor
Putnam, H.D., Ph.D., Professor
Pyatt, E.E., Dr.Eng., Professor
Singley, J.E., Ph.D., Professor
Urone, P., Ph.D., Professor

GEOLOGY

Blanchard, F.N., Ph.D., Associate Professor
Brooks, H.K., Ph.D., Professor
Eades, J.L., Ph.D., Associate Professor
Edwards, R.A., Ph.D., Professor
Griffin, G.M., Jr., Ph.D., Professor
Mifflin, M.D., Ph.D., Associate Professor
Nicol, D., Ph.D., Associate Professor
Patton, T.H., Ph.D., Assistant Professor
Pierce, R.W., Jr., Ph.D., Assistant Professor
Pirkle, E.C., Jr., Ph.D., Professor
Randazzo, A.F., Ph.D., Assistant Professor
Rappenecker, C., Ph.D., Professor
Wahl, F.M., Ph.D., Professor
Webb, S.D., Ph.D., Associate Professor

ZOOLOGY

Auffenberg, W., Ph.D., Professor
Austin, O.L., Jr., Ph.D., Associate Professor
Berner, L., Ph.D., Professor
Brodkorb, P., M.D., Professor
Brookbank, J.W., Ph.D., Professor
Carr, A.F., Jr., Ph.D., Graduate Research Professor
Carr, W.E.S., Ph.D., Assistant Professor
DeWitt, R.M., Ph.D., Associate Professor
Dickinson, J.C., Jr., Ph.D., Associate Professor
Emmel, T.C., Ph.D., Assistant Professor
Giesel, J.T., Ph.D., Assistant Professor
Gilbert, C.R., Ph.D., Assistant Professor
Gregg, J.H., Ph.D., Professor
Johnson, F.C. II, Ph.D., Associate Professor
Johnston, D.W., Ph.D., Associate Professor
Jones, E.R., Jr., Ph.D., Professor
Kaufmann, J.H., Ph.D., Associate Professor
Kilby, J.D., Ph.D., Associate Professor
Laessle, A.M., Ph.D., Associate Professor
Lanciani, C.A., Ph.D., Assistant Professor
Leavitt, B.B., Ph.D., Associate Professor
Maturo, F.J.S., Ph.D., Associate Professor
McNab, B.K., Ph.D., Associate Professor
Nordlie, F.G., Ph.D., Associate Professor

Patton, T.H., Ph.D., Assistant Professor
Prange, H.D., Ph.D., Assistant Professor
Reiskind, J., Ph.D., Assistant Professor
Wallace, H.K., Ph.D., Professor
Wallbrunn, H.M., Ph.D., Associate Professor
Webb, S.D., Ph.D., Associate Professor
Westfall, M.J., Jr., Ph.D., Professor
Zam, S.G., Ph.D., Assistant Professor

To obtain further information, address all inquiries directly to:

Director
Center for Aquatic Studies
2001 McCarty Hall
University of Florida
Gainesville, Florida 32601

FLORIDA INSTITUTE OF TECHNOLOGY
Melbourne, Florida 32901

Florida Institute of Technology (F. I. T.) offers two broad programs in the marine sciences. Research programs leading to the Bachelor of Science degree and all graduate programs are in the School of Sciences and Engineering located on the main campus at Melbourne, Florida. Technological training is centered in the School of Marine and Environmental Technology at Jensen Beach, Florida (see below).

The School of Sciences and Engineering

The principal laboratories, classrooms and library are located on the main campus at Melbourne. Separate laboratories are provided for physical oceanography, chemical oceanography, soils, sediments and geology, fluid mechanics (includes a 23-foot wave tank and a hydraulic flume), general biology, marine biology and micro-biology.

R/V Sea Hunter II, a 72-foot steel-hull twin screw cruiser, equipped with electronic-hydraulic oceanographic winch, Loran, Lorac, and capable of obtaining physical, chemical, biological and geological samples, is based at the F. I. T. operating base, located 45 miles to the south at the Marine Science Center near Ft. Pierce, Florida. Plans call for building a new research facility at the Marine Science Center. This will permit the offering of a Ph. D. program in the near future. It is expected that these plans will be realized during the period covered by this publication, and the proposed Ph. D. program is described below.

River and estuarine research is based at Melbourne and is largely done by small craft from a 40-foot houseboat fitted as a floating laboratory. This is being augmented by a laboratory trailer, now being outfitted. It will be used as a moveable base along the rivers and estuaries. Combined student registration for the Departments of Biological Sciences and the Department of Oceanography and Ocean Engineering for fall of 1972 was 752, including 31 candidates for the masters degree.

The following degrees are offered:

Department of Biological Sciences: B.S. in Marine Biology - 191 quarter-hours required, B.S. in Ecology and Environmental Biology - 191 quarter-hours required, M.S. in Marine Biology - 48 quarter-hours of required and elective work, up to nine credits may be elected for thesis work and M.S. in Microbiology - same as Marine Biology.

Department of Oceanography and Ocean Engineering: B.S. in Oceanography - with options after first two years in physical oceanography, chemical oceanography and biological oceanography - Completion of 193 quarter-hours is required and elective work. There were 18 graduates in 1972.

The following courses are offered in conjunction with the above programs:

B-4025	General Physiology	3
B-4026	Experimental Physiology	2
B-4051	Developmental Biology	5
B-4041	Marine Biology	3
B-4045	Marine Ecology	3
B-4015	Environmental Biology	4
O-1001	Oceanography Problem Solving	3
O-3001	Introduction to Oceanography	3
O-3002	Chemical Oceanography	3
O-3081	Oceanography Lab I	2
O-3003	Physical Oceanography	3
O-3082	Oceanography Lab II	2
O-4003	Dynamic Oceanography I	3
O-4004	Dynamic Oceanography II	3
OE-3503	Marine Geology	3
OE-3583	Marine Geology Lab I	1
OE-3501	Fluid Mechanics I	3
OE-3581	Fluid Mechanics Lab I	1
OE-3502	Fluid Mechanics II	3
OE-3504	Instrumentation & Measurement Analysis	3
OE-3505	Ocean Engineering Design I	3
OE-3582	Fluid Mechanics Lab II	1
OE-4501	Optical Oceanography	3
OE-4581	Optical Oceanography Lab	1
OE-4506	Ocean Engineering Design II	3
OE-4502	Hydroacoustics	3
OE-4505	Ocean Waves	3
OE-4582	Hydroacoustics Lab	1

GRADUATE

B-5006	Advances in Cell & Molecular Biology	3
B-5007	Current Topics in Microbiology	3
B-5008	Advanced Microbiology	3
B-5020, 21	Comprehensive Biochemistry I, II	3, 3
B-5230	Advanced Plant Physiology	3
B-5450	Advanced Invertebrate Zoology	3
B-5510	Current Topics in Ecology	3
B-5005	Environmental Biology	3
B-5015	Environmental Biology Lab	2
B-5025	Biochemical Techniques	3
B-5030	Field Ecology	3
B-5100	Electron Microscopy	3
B-5540	Advanced Marine Ecology	3
B-5605	Concepts of Parasitism	3
O-5001	Introduction to Physical Oceanography	3
O-5003	Chemical Oceanography I	3
O-5005	Geological Oceanography	3
O-5006	Hydroacoustics I	3
O-5011	Tides & Tidal Currents	3
O-5016	Marine Meteorology	3
O-5013	Statistical Methods in Oceanography	3

B.S. in Ocean Engineering - Completion of 193 quarter hours in required and elective work.

M.S. in Oceanography with option in physical oceanography or bio-environmental science - Completion of 48 hours of required and elective work (including thesis). There were 10 masters' degrees awarded in 1972.

Ph.D. in Oceanography with emphasis on marine studies in the coastal margins. This program has been planned with the possibility of offering it in 1973. It will be a joint offering of the Department of Oceanography and Ocean Engineering and the Department of Biological Sciences. Students who have received a master of science degree in mathematics, natural science, engineering of the equivalent preparation are eligible to apply. Scholastic excellence and appropriate recommendations are also required. Applicants must have completed one year of college work in physics, calculus and chemistry. There are further detailed requirements for the student concentrating in marine ecology, chemical oceanography or

physical oceanography. The aim of the program is to offer interdisciplinary instruction in sufficient depth to permit concentration on a special field of interest in the coastal zone.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

B-1001	General Biology	3
B-1011	Introduction to Exp. Biology	2
B-1002	General Biology	3
B-1012	Introduction to Exp. Biology	2
B-1003	General Biology	3
B-1013	Introduction to Exp. Biology	2
B-2031	Microbiology I	3
B-2041	Micro. Techniques	2
B-2032	Microbiology II	3
B-2042	Micro. Techniques	2
B-2033	Microbiology III	3
B-2043	Micro. Techniques	2
B-3031	Cell Biology	3
B-3032	Exp. Cell Biology	3
B-3041	Plant Biology	3
B-3042	Plant Biology Lab	2
B-3033	General Biochemistry	3
B-3035	Exp. Biochemistry	2
B-3045	Invertebrate Zoology	3
B-3046	Invertebrate Zoology Lab	2
B-3038	Molecular Biology	3
B-3039	Molecular Biology Lab	2
B-3048	Vertebrate Zoology	3
B-3049	Vertebrate Zoology Lab	2
B-4011	Ecology I	4
B-4021	Molecular Genetics	3
B-4022	Exp. Genetics	2
B-4012	Ecology II	4
O-5009	Dynamic Oceanography I	3
O-5012	Ocean Waves	3
O-5004	Chemical Oceanography II	3
O-5014	Legal-Environmental Relationships	3
O-5081	Sea Lab Techniques	2
O-5002	Biological Oceanography	3
O-5015	Estuarine Processes	

Fulltime faculty of the departments concerned are listed below:

BIOLOGICAL SCIENCES

Clark, K. B., Ph. D., Assistant Professor
Cohen, G. M., Ph. D., Assistant Professor
Daggett, J. M., B. S., Instructor
Denius, H. R., Ph. D., Assistant Professor
Morris, J. G., Ph. D., Assistant Professor
Paltzik, A. E., M. S., Assistant Professor
Webster, G. C., Ph. D., Professor, Head

OCEANOGRAPHY AND OCEAN ENGINEERING

Dubbleday, P. S., Ph. D., Professor
Kalajian, E. H., Ph. D., Assistant Professor
Lasater, J. A., Ph. D., Professor
Nevin, T. A., Ph. D., Professor
vonZweck, O., Ph. D., Assistant Professor
Waters, O. D., Jr., B. S., Professor, Head

For further information, address all inquiries to:

Dr. R. A. Work, Jr.
Dean of Student Affairs
Florida Institute of Technology
Melbourne, Florida 32901
(305) 723-3701, ext. 230

The Jensen Beach campus occupies 84 acres between the Indian and St. Lucie Rivers on the east coast of Florida. 2,900 feet of waterfront exists on the Indian River, with dockage facilities for the school's small boats. The school owns two research vessels, the 50-foot Joie de Vivre and the 65-foot Aquarius. They are diesel with chemical, biological and electronic laboratories and accommodations for ten sutdents, two instructors, and crew for long voyages. They are docked at nearby deep-water locations. These vessels can cruise up to 1,500 miles and are staffed by licensed captains and are fully equipped with radar, loran, and modern electronic communication and navigation systems. Two winches, and four platforms on each vessel permit simultaneous sampling of continental and offshore waters.

Buildings include classrooms, biology, chemistry, environmental, electronics, photography and oceanographic laboratories, lecture theatres, an auditorium, a library and a swimming pool and diving training facility. Research equipment include: salinometers; atomic absorption and I. R. spectrophotometers; photometers; S. T. D.'s; pingers sparkers; shallow mid and deep water nets; corers; drags; Ph meters; microscopes with oil immersion objectives; aquariums; centrifuges; kymographs; autoclaves; a water chemistry laboratory, and a 30-foot river research vessel. Complete diving for 30 students is provided, including a school-owned recompression chamber. A diving tank and hard-hat facilities will be installed in the near future.

The degrees currently offered are: Associate of Science (oceanographic technology, marine science technology, oceanographic electronics technology and environmental technology. Bachelor of Technology (oceanographic technology and environmental technology).

Fifty-eight students graduated in oceanographic technology in the 1972 academic year. Three hundred and sixty-six students are currently enrolled. Summer courses are also conducted for high school students entering college in the fall with earned credit. College students can also enroll in a five-week, 12-credit course in advanced scuba, underwater photography, and advanced biology, plus a research project.

Courses offered in conjunction with the above programs include:

Introduction to Oceanography	2
Practical Oceanography I	1
Small Boat Handling and Seamanship	3
Oceanographic Data I	3
Oceanographic Data II	3
Ocean Biology I	3
Ocean Chemistry I	3
Oceanographic Equipment I	3
Oceanographic Instrumentation I	3
Ocean Project I	6
Ocean Geology	3
Ocean Biology II	3
Ocean Chemistry II	3
Physical Oceanography I	3
Introduction to Oceanographic Engineering	3
Oceanographic Data III	3
Physical Oceanography II	3
Oceanographic Engineering I	5
Oceanographic Equipment II	3
Oceanographic Instrumentation II	3
Ocean Project II	6
Underwater Acoustics	3
Underwater Structures	3
Salvage	3
Oceanographic Engineering II	5
Ship Propulsion Systems	3
Nautical Science I	3
Nautical Science II	3
Marine Power Systems	3
Navigation I	3
Cargo Handling and Stowage	2
Stability and Ship Construction I	3
Introduction to Communications	2
Marine Meteorology	3
Navigation II	3
Advanced Seamanship	3
Coast Guard & Federal Rules & Regulations	3
Stability and Ship Construction II	3
Communications Laboratory I	1

Navigation III	3
Communications Laboratory II	1
Ship Management	2
Safety of Life at Sea	2
Coast Guard License Preparation	3
Shipboard Computers	3
Electricity	3
Electronics	3
Marine Power Systems	3
Advanced Electronics I	5
Calibration and Standardization	3
Network Analysis	3
Fabrication Techniques Laboratory	3
Advanced Electronics II	5
Electronic Navigation I	3
Oceanographic Instrumentation I	3
Shipboard Computers	3
Electronics Laboratory I	1
Marine Electronic Communications	3
Electronic Navigation II	3
Oceanographic Electronic Instrumentation	3
F. C. C. License Preparation	3
Electronics Laboratory II	1
Electronics Project	3
Seminar in Environmental Problems	3
Environmental Biology I	3
Environmental Biology II	3
Environmental Biology III	3
Pollution Analysis I	3
Environmental Biology IV	3
Microbiology	4
Pollution Analysis II	3
Environmental Experimentation I	3
Environmental Instrumentation II	3
Field Project I	3
Legal Aspects of Environmental Protection	3
Waste Water Disposal	3
Bacteriology	4
Equipment Servicing Techniques	3
Pollution Analysis III	3
Photographic Water Quality Analysis I	3
Statistics	5
Environmental Instrumentation III	3
Photographic Water Quality Analysis II	3
Estuarine Ecology	4
Strength of Materials	3
Meteorology (Environmental)	3
Gaseous Emissions Control	3
Sanitary Engineering	3
Research Methodology	3
Ecological Baselines	3
Toxic Substances in Ecosystems	4
Field Project II	6
Solid Waste Disposal	3
Water Treatment	3
Advanced Instrumentation	3
Basic Photography	1
Documentation	2
Underwater Photography	3
Advanced Photography	3
Micro-Macro Photography	3
Infrared Photography	3
Environmental Photography I	3
Environmental Photography II	3
Scuba Diving	1
Intermediate Scuba Diving	2
Advanced Scuba Diving	3
Machine Shop Practices I	3
Welding Techniques I	3
Machine Shop Practices II	3
Welding II	3

Instructional staff includes the following:

Atwill, William D., B. A., English
Brown, Edwin C., B.S., Biology
Clay, Richard, M.S., Electronics
Collins, Cecil, B.S., Nautical Science
Dallemagne, Pierre, B.S., Oceanography
Forsman, Robert, M.S., Mathematics
Gross, John, Ph.D., Chemistry
Hillen, Jon, M.S., Biology
Hutchins, John, B.F.A., Fine Arts, Photography
Iliffe, Thomas, M.S., Oceanography, Chemistry
Josephson, Julian, B.S., Chemistry
LeMoal, Gilbert, M.S., Ocean Engineering
Orfanoudakis, Nikos, B.S., Mathematics
Ward, Arthur, M.S., Electrical Engineering
Woodberry, James, B.S., Natural Science

For further information please address inquiries to:

Mr. Peter Navaretta
Director of Student Affairs
Florida Institute of Technology
720 South Indian River Drive
Jensen Beach, Florida 33457

FLORIDA STATE UNIVERSITY
Tallahassee, Florida

The primary purpose of the Department of Oceanography of the Florida State University at Tallahassee is to administer a program of academic studies and associated research leading to the M.S. and Ph.D. degrees in Oceanography. The department has been designated by the Board of Regents of the State of Florida as the single agency in the state system authorized to prepare students for the Ph.D. in Oceanography. The areas of specialization at Florida State include biological, chemical, geological and physical oceanography.

Oceanography Department headquarters, offices and laboratories are in the Physical Sciences/Administration Building, located in the science area on the west side of the campus. Additional laboratories are in temporary quarters nearby and in the Nuclear Research Center. An Antarctic Marine Geology Research Facility located in the Geology Building on campus acts as a national repository for the storage and a laboratory for the analysis of cores being collected in the National Science Foundation Antarctic Research Program. Research conducted in conjunction with the Geophysical Fluid Dynamics Institute is housed in the GFDI laboratories in the Keen Building. In common with other departments on campus, classes are conducted in these or nearby buildings. The university computing center, equipped with a Control Data Corporation 6500 Computer, is available for instructional and research purposes.

The coastal laboratory for Florida State University is the Edward Ball Marine Laboratory on the Gulf of Mexico, 43 miles southwest of Tallahassee. The marine facility, constructed in 1968, includes laboratories for geochemical, microbiological, geological, physiological and ecological oceanographic research as well as a lecture hall and limited dormitory space for visiting personnel and students. The Tursiops, a sea-going research vessel 65 feet long, and a number of smaller craft are moored at the marine station. Deep-sea operations are frequently carried out through cooperative arrangements with other oceanographic institutions.

Library facilities on the main campus are excellent, and an additional reference library is maintained at the marine station.

An applicant for admission to the Department of Oceanography Graduate program must hold, or be a candidate for, a baccalaureate degree from an approved college or university and be in good standing in the school last attended, present evidence of an average of B or better in both undergraduate and prior graduate academic work and attain a score of 1,110 on the Verbal Aptitude and Quantitative Aptitude Tests of the Graduate Record Examination.

Graduate students working toward a degree in oceanography are expected to acquire a basic background in all aspects of oceanography and at the same time to develop a high level of excellence in their chosen specialty, e.g., chemical, physical, geological or biological oceanography or some combination of these. An applicant must elect a tentative area of specialization in oceanography and should have substantial undergraduate work in at least one of the following areas: biology, chemistry, engineering, geology, mathematics, meteorology or physics.

All graduate students will normally be expected to have completed mathematics through differential and integral calculus, an equivalent of one year of physics, and one year of chemistry; additional prerequisites may be set by the specialty areas within the department, such as physical chemistry, advanced applied mathematics, and advanced geological or biological subjects. The student's prior training should support the chosen area of specialization.

The thesis-type Master's program is required in oceanography. Fifty-four quarter hours are required, made up of 45 quarter hours of course work and nine quarter hours of thesis.

Of the required course work at least 27 quarter hours must be taken in oceanography. A minimum of 18 quarter hours must be taken at the 500 level but not necessarily confined to oceanography courses. The Department of Oceanography makes no mandatory department-wide requirement of any foreign language for the M.S. degree. In specific cases, however, a student's advisory committee may require demonstration of foreign language skills appropriate to the student's specialty.

The department requires that each student preparing for the M.S. degree attain a grade of A or B in each of the introductory survey courses.

The Ph.D. degree in oceanography is not awarded upon the completion of any specific number of courses or at the end of any specified period. Candidates must demonstrate that they have mastered the field of oceanography and are capable of doing independent scholarly research. A student planning study toward the Doctor of Philosophy degree in the Department of Oceanography must first be admitted by the department explicitly for such study. That specific admission will be determined by a departmental committee and be certified to the departmental chairman and to the F.S.U. graduate admissions office. Part of such certification must be the naming of a specific faculty member who has agreed to act as the student's advisor.

The candidate for the Ph.D. degree will usually take 27 quarter hours of formal course work in areas related to his specialty, in addition to the general M.S. requirements. Under unusual circumstances a student may be permitted to work toward the Ph.D. degree without completing the M.S. degree, but in that case the M.S. minimum course requirement of 45 quarter hours must be fulfilled.

A doctoral thesis prospectus should be submitted by the fifth quarter of the student's Ph.D. residence, following which a doctoral thesis must be completed, orally defended, and at least a portion of it submitted to a reputable scientific publication before the Ph.D. degree can be awarded.

An interdepartmental graduate program of study related to oceanography is offered leading to the Doctor of Philosophy degree in Geophyscial Fluid Dynamics. The program is supported by the research programs and facilities of the Geophysical Fluid Dynamics Institute. The fields of oceanography, geology, meteorology and mathematics are included in this graduate program. Inquiries should be directed to the program director, Geophysical Fluid Dynamics Institute, 18 Keen Building, Florida State University.

The Department of Biological Science has developed a marine biology program which places less emphasis on the broad interdisciplinary aspects of oceanography (physics, mathematics and chemistry) and more emphasis on special biological problems. Students interested in such a program should write to the associate chairman for Graduate Studies of the Department of Biological Science, Florida State University.

Courses offered in connection with the above programs include:

UNDERGRADUATE

107	Introduction to Oceanography	3
107L	Introduction to Oceanography	1
157	Air and Water Pollution Mechanisms	3
301	Introduction to Oceanography	3
339	Marine Climatology	3

UNDERGRADUATE AND GRADUATE

444	Radioactivity of the Atmosphere and Hydrosphere	3
447	Chemical Thermodynamics of Atmospheric Gases	3
500	Elementary Physical Oceanography	4
501	Introduction to Physical Oceanography	3
502	Dynamic Oceanography	4
504	Marine Hydrodynamics	3
505	Ocean Waves	3
506	Ocean Circulation	3
507	Turbulence	3
508	Geophysical Measurements	3
509	Estuary and Coastline Hydrodynamics	3
514	Dynamics and the Upper Ocean	3
515	Experimental Oceanography	4
518r	Special Problems in Physical Oceanography	3
520	Elementary Biological Oceanography	4
521	Advanced Biological Oceanography	4
522	Deep Sea Ecology	3
522L	Deep Sea Ecology	3
523	Zooplankton Ecology	4
524	Marine Phytoplankton Physiological Ecology	3
525	Primary Production in Aquatic Environments	4
526	Marine Ecosystem Dynamics	3
527	Fishery Biology	3
528r	Special Problems in Biological Oceanography	3
530	Marine Biocenology	4
532	Estuarine Biology	3
533	Ecology of Shallow Water Benthic Communities	4
535	Estuarine Pollution	3
536	Mariculture	4
539	Broader Problems in Geochemistry	3
540	Elementary Chemical Oceanography	4
541	Marine Chemistry - Bio-organic Aspects	3
542	Marine Chemistry - Physical/Inorganic Aspects	3
545	Chemical Limnology	3
548r	Special Problems in Chemical Oceanography	3
551	Introduction to Fluid Dynamics	3
552	Dynamics of Incompressible Fluids	3
553	Geophysical Applications of Fluid Dynamics	3
557	Physics of the Air-Sea Boundary Layer	3
561	Oceanic Biogeography	3
562	Geomicrobiology	4
564	Marine Microbiology	4
565	Applied Biogeochemistry	3
569	Broader Problems in Geophysics and Crystal Chemistry	3
570	Elementary Geological Oceanography	4
574-575	Shoreline Geology	3-2
578r	Special Problems in Geological Oceanography	3
580	Advanced Sedimentology	4
581	Bathymetry, Structure and Tectonics of the Ocean Basins	3
586	Environments of Marine Deposition	4
591r	Directed Individual Study (These courses are offered to meet the requests for individual work by students.)	3-12
595r	Oceanography Seminar	1
597r	Supervised Research	1-9
598r	Supervised Teaching	1-9
599	Thesis (Individual research in oceanography is to be planned with the major professor	5-9
629r	Advanced Topics in Geophysical Fluid Dynamics	3
681r	Advanced Topics in Hydrodynamics	3

695	Seminar	1
699	Doctoral Dissertation	18

To obtain further information, address all inquiries directly to:

Admissions Committee
Department of Oceanography
Florida State University
Tallahassee, Florida 32306

FULLERTON COLLEGE
Fullerton, California 92634

Standard laboratory facilities and classrooms, ship time donated by local institutions and government agencies and visits to regional industrial facilities provide instructional situations.

The Fullerton College program in oceanographic technician training is designed to prepare entry-level technicians in marine-oriented operations. The curriculum grants the Associate in Arts degree, enabling students to transfer to senior institutions to pursue an academic rather than a vocational-technical goal.

Basic oceanographic science and associated subjects are provided in campus facilities. Special equipment, research situations, ship management and "hands-on" training require off-campus opportunities, frequently using donated facilities.

In-year and summer experiences with shipboard or onshore work programs provide the student with actual on-the-job-conditions and credits for up to eight units.

The following courses are offered in conjunction with the above program:

1	General Biology	5
25	Marine Biology	3
49A	Life Sciences Independent Study	1
49B	Life Sciences Independent Study	1
49C	Life Sciences Independent Study	1
30	Introduction to Ocean Science	3
32A	Oceanographic Materials and Instruments	3
32B	Oceanographic Materials and Instruments	3
33	Navigation-Drafting	4
54	Cooperative Oceanographic Technology	2-8
A	Trigonometry and Elementary Functions	5
1	Physical Geology	3
1L	Physical Geology Lab	1
3	Introduction to Chemistry	5
2A	College Physics	3
2B	College Physics	3
3A	College Physics Laboratory	1
3B	College Physics Laboratory	1
1A	General Zoology	5
1B	General Zoology	5
5A	Principles of Biology	4
5B	Principles of Biology	4
81A	Technical Mathematics	3
81B	Technical Mathematics	--
10	Elementary Physics	4
43	Marine Electronics Instrumentation	3

To obtain further information, address all inquiries directly to:

Howard Craig, Coordinator
Oceanographic Technology Program
Fullerton College
321 East Chapman Avenue
Fullerton, California 92634

GEORGE WASHINGTON UNIVERSITY
Washington, D. C. 20006

The university offers marine science courses at its main campus in downtown Washington, D. C. and at a number of off-campus facilities within easy reach of the university.

The Bachelor of Science degree in Oceanography is offered by and under the jurisdiction of the Columbian College, the liberal arts college of the university, and is administered by the College of General Studies. All students are required to satisfy many of the undergraduate requirements for the Bachelor of Science Degree. In addition, specialization in oceanography is obtained by taking a minimum of 21 hours in oceanography and additional work in biology, chemistry, geology, geophysics, mathematics and physics. The students take the professional courses in oceanography at the off-campus facilities. The balance are taken on-campus by full time students; these students participate in all normal University activities.

The following courses are offered in conjunction with the above program:

OCEA	11 Navigation	3
OCEA	101 Elementary Oceanography 1	3
OCEA	102 Elementary Oceanography 2	3
OCEA	110 Physical Oceanography	3
OCEA	111 Ocean Waves and Tides	3
OCEA	112 Biological Oceanography	3
OCEA	113 Marine Geophysics	3
OCEA	114 Chemical Oceanography	3
OCEA	115 Geological Oceanography	3
GEOP	105 Elementary Geophysics	3
GEOP	106 Interpretation Theory-Geophysics	3
GEOP	115 Elementary Seismology	3
CART	107 Physiography	3
CART	108 Climatology	3

The instructional staff for the courses listed above consists of the following:

Anderson, Neil R., Ph. D., Assistant Professorial Lecturer
Dill, Robert, Ph. D., Assistant Professorial Lecturer
Hicks, Steacy D., M. S., Associate Professorial Lecturer
Long, Edward, M. S., Lecturer
Morrison, Robert E., Ph. D., Associate Professorial Lecturer
Orlin, Hyman, Ph. D., Program Adviser and Professorial Lecturer
Rucker, James B., Ph. D., Professorial Lecturer

To obtain further information, address all inquiries directly to:

Director of Credit Programs
College of General Studies
The George Washington University
706 20th Street, N. W.
Washington, D. C. 20006

UNIVERSITY OF GEORGIA
Athens, Georgia 30602

The university offers the M.S. and Ph.D. degrees with emphasis on marine science in four departments, botany,

geology, microbiology and zoology, and in the School of Forest Resources. No degrees specifically designated as marine science or oceanography are offered. Specific degree requirements vary slightly among the departments, but, in general, 40 credit hours of formal course work, a thesis and a reading knowledge of one foreign language, as well as satisfactory performance on a comprehensive examination in the basic science field involved, are required for the M.S. degree. Formal course requirements for the Ph.D. are flexible, the program being determined by the student in consultation with his advisory-committee. Preliminary written and oral examinations and a final oral examination are administered by the department. A dissertation and, in some departments, a reading knowledge of a second foreign language are also required for the Ph.D.

Modern research facilities in marine sciences are available on the Athens campus. at the university's Marine Institute on Sapelo Island, Georgia, and at the Skidaway Institute of Oceanography on Skidaway Island, Georgia. In addition, staff and graduate students participate in studies utilizing federally supported ships and other facilities not owned by the university. Research vessels based at Sapelo and Skidaway are equipped to carry out investigations on the continental shelf and slope as well as in the estuaries. Small boats are maintained for work in the extensive estuaries and salt marshes of the area. Research at Sapelo is centered mainly on marsh ecology, with emphasis on the production and transformation of organic matter. At Skidaway, current research activites include studies on environmental quality problems in estuarine and marine waters, mariculture, geochemistry and geology of the barrier islands and Pleistocene shelf deposits.

At Sapelo, the laboratories occupy more than 10,000 square feet of space provided by the Sapelo Island Research Foundation. Living accommodations on the island, also provided by the foundation, include family housing units for staff and dormitory space for 18.

The Skidaway Institute of Oceanography, a unit of the university system, serves as a marine research facility for all institutions in the system, including the University of Georgia. The institute is housed in modern laboratories occupying 18,000 square feet. A temporary dormitory capable of accommodating up to 15 people is available. Construction of a 54-unit dormitory is scheduled to be completed in 1974.

Also located on Skidaway Island is the university's Marine Extension Center, a 19,000-square-foot facility including an exhibit area, four teaching laboratories, and conference and seminar rooms.

The following courses are offered in conjunction with the above program. Advanced courses that are wholly or in part marine in aspect are listed by department. Courses numbered 800 or above are strictly graduate; the others are senior-graduate.

DEPARTMENT OF BOTANY

610	Growth and Development of Algae	5
611	Biochemistry of Algae	5
628	Nonvascular Plants	5
832	Biology of Phycomycetes	5
860	Aquatic Plants	5
862	Marine Botany	5

SCHOOL OF FOREST RESOURCES

636	Fish Ecology	5
736	Fishery Management Techniques	5

DEPARTMENT OF GEOGRAPHY

601	Advanced Climatology	5
602	North American Physiography	5
620	Use and Interpretation of Aerial Photographs	5
622	Advanced Photogrammetry Laboratory	5
623	Remote Sensing	5

DEPARTMENT OF GEOLOGY

603	Invertebrate Paleontology	5
605	Sedimentation and Stratigraphy	5
609	Marine Geology	5
610	Sedimentary Petrology	3
612	Palynology	5
630	Clay Mineralogy	4
639	Introduction to Geophysics	5
641	Introduction to Research in Oceanography	5
645	Geochronology and Isotope Geology	5
651	Micropaleontology	5
652	Introduction to Paleoecology	5
660	Geochronology	5
811	Petrography and Petrology of Sedimentary Rocks	3
815	Special Problems in Sedimentology and Oceanography	5
825	Plate Tectonics	3
830	Mineral Paleontology	5
831	Coastal Geology of Southeastern U.S. (Skidaway)	5

DEPARTMENT OF MICROBIOLOGY

622	Aspects of Microbial Ecology	5
860	Physiology of Bacteria	5

DEPARTMENT OF ZOOLOGY

605	Ichthyology	5
660	Marine Ecology	5
800	Bioenergetics and Ecosystems	5
807	Advanced Invertebrate Zoology	5
808	Advanced Invertebrate Zoology	5
810	Limnology and Oceanography	5
811	Marine Biology	5
812	Freshwater Biology	5
813	Hydrobiology Seminar	1
854	Physiological Ecology	5
855	Population Ecology	5
856	Ecology Seminar	1
857	Pollution Ecology	5
858	Systems Ecology I	3
859	Systems Ecology II	3
868	Systems Ecology Dynamic Analysis I	5
869	Systems Ecology Dynamic Analysis II	5

The instructional staff for the courses listed above consists of the following:

BOTANY

Darley, W. Marshall, Ph.D., Assistant Professor
Duncan, Wilbur H., Ph.D., Professor
Dunn, E. Lloyd, Ph.D., Assistant Professor
Fuller, Melvin S., Ph.D., Professor
Kochert, Gary, Ph.D., Associate Professor
Porter, David, Ph.D., Assistant Professor

SCHOOL OF FOREST RESOURCES

Dudley, Richard G., Ph.D., Assistant Professor of Fisheries
Clugston, James P., Assistant Unit, Cooperative Fishery Unit, USFWS
Fox, Alfred C., Ph.D., Unit Leader, Cooperative Fishery Unit, USFWS, and Assistant Professor of Fisheries

GEOLOGY

Carver, Robert E., Ph.D., Assistant Professor
Frey, Robert W., Ph.D., Assistant Professor
Noakes, John E., Ph.D., Associate Professor and Director, Geochronology Laboratory
Sen Gupta, Barun, Ph.D., Assistant Professor

MICROBIOLOGY

Eagon, Robert G., Ph.D., Professor
Finnerty, William R., Ph.D., Associate Professor

Payne, William J., Ph.D., Head and Alumni Foundation Professor
Wiebe, William J., Ph.D., Associate Professor

ZOOLOGY

Chin, Edward, Ph.D., Associate Professor
Cosgrove, W.B., Ph.D., Alumni Foundation Professor
Frankenberg, Dirk, Ph.D., Professor
Johannes, R.E., Ph.D., Associate Professor
Odum, Eugene, Ph.D., Alumni Foundation Professor
Patten, B.C., Ph.D., Professor
Pomeroy, L.R., Ph.D., Professor
Scott, Donald C., Ph.D., Professor
Thomas, Grace J., Ph.D., Associate Professor

INSTITUTE OF OCEANOGRAPHY, SKIDAWAY ISLAND

Andrews, James, Ph.D., Assistant Professor, Agricultural Experiment Station
Atkinson, L., Ph.D., Assistant Professor
Dunstan, William, Ph.D., Assistant Professor
Gardner, Wayne, Ph.D., Assistant Professor
Henry, V.J., Ph.D., Professor
Howard, James, Ph.D., Associate Professor
el-Ibiary, Hussein M., Ph.D., Research Associate, Agricultural Experiment Station
Menzel, D.W., Ph.D., Director
Sick, Lowell, Ph.D., Assistant Professor
Stickney, Robert, Ph.D., Assistant Professor
Windom, Herbert, Ph.D., Associate Professor

MARINE INSTITUTE, SAPELO ISLAND

Gallagher, John, Ph.D., Research Associate
Hall, John, Ph.D., Research Associate
Maurer, L.G., Ph.D., Research Associate
Menzel, D.W., Ph.D., Director
Reimold, R.J., Ph.D., Research Associate

MARINE EXTENSION CENTER, SKIDAWAY ISLAND

Harding, James L., Ph.D., Geological Oceanographer
Miller, David, M.S., Curator

MARINE EXTENSION OFFICE, BRUNSWICK

Bartlett, Martin R., Fisheries Specialist
Harrington, D.L., B.S., Marine Fisheries Specialist
Higgins, James, Marine Fisheries Specialist

To obtain further information, address all inquiries directly to:

Graduate Coordinator
(department of interest)
University of Georgia
Athens, Georgia 30602

CLOVER PARK EDUCATION CENTER
Lakewood, Washington 98499

The Clover Park Education Center has focused on serving the commercial fishing industry of Washington by providing technical assistance and training to the people who man the nearly 10,000 fishing vessels licensed in the state.

The Center now sponsors a one-year Commercial Fisherman Crewmember Training Program which provides that service to the fishing industry. The member is trained for employment in all aspects of the fishing industry. Topics include network navigation, net mending cooking, boat handling, types and methods of commercial fishing, safety and first aid, marine machinery. Actual work experience at sea is provided on a charter vessel. The Center plans the purchase of a permanent vessel. Applicants to this program must be over 16 years of age and have completed the 11th grade.

The center also provides training on a continuing education basis through courses and seminars concerning such topics as new laws and regulations, net mending, cable splicing, net construction, hydraulics, electronic equipment operation, and maintennnce of depth sounding equipment such as loran, radar, sonar, depth recorder, plus engine maintenance and operation. Emergency first aid, accounting and income tax is also included.

For further information, contact:

Mr. John Ronning
Clover Park Education Center
4500 Steilacoom Boulevard Southwest
Lakewood, Washington 98499
(206) 584-7611

GRAYS HARBOR COLLEGE
Aberdeen, Washington 98520

In September 1970, a two-year vocational curriculum in fish and game management was instituted; in January 1973, 55 students were enrolled in this program.

The college is located on an estuary, Grays Harbor, which borders on the Pacific Ocean. Classes such as fisheries biology, oceanography and marine biology benefit by the proximity to ocean troll, drag fisheries, and gill net fishing in various rivers.

The college's physical facilities are located on a modern campus which includes a four-acre lake used in fisheries and limnology classes. The science laboratories include three for biology, two for chemistry and one each for geology and oceanography. Vocational shops include welding, carpentry, automotive, machine lathes, electronics and data processing.

The college is involved in several Sea Grant projects such as mariculture and collection of basic marine environmental data in which students are employed.

Research equipment includes a 16-foot runabout, various oceanographic samplers, experimental nets, and other fishing gear. High seas vessels are chartered for ocean study by various classes.

In addition to the two-year vocational program, a number of students are enrolled here in the first two years of a bachelor of science program, such as the one offered by the University of Washington.

The following degrees are offered:

1) Associate of Applied Arts. Ninety-three credit hours including three hours of physical education and a major in a technical field.

2) Associate of Science. Ninety-three credit hours including three hours of physical education and completion of a major in an approved curriculum.

The following courses are offered in conjunction with the above programs.

FIRST YEAR

Intermediate Algebra	5
Chemical Science	10
Introduction to Fisheries	2
Physical Science	5
General Biology	10
Marine Biology	5

Instrumentation for Life Science	3
Seamanship	1
Electives	4
Physical Education	2

SECOND YEAR

English Composition	6
Ecology	5
Introduction to Forestry	2
Fisheries Biology	3
Game Management	2
Geology	5
Oceanography	5
Introduction to Data Processing	3
First Aid and Safety	3
Water Resources	3
Electives	8
Physical Education	1

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Clothier, Glen, Ph.D., Assistant Professor
Messmer, Louis, M.S., Professor
Robinson, Myles, Ph.D., Associate Professor
Smith, John, Ph.D., Professor

CHEMISTRY

Schermer, Eugene, Ph.D., Professor

FISHERIES

Johnson, Eugene, M.S., Commercial Fisheries Agent

OCEANOGRAPHY

Phipps, James, M.S., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. John M. Smith
Grays Harbor College
Aberdeen, Washington 98520
(206) 532-9020, ext. 317/318

UNIVERSITY OF GUAM
Agana, Guam 96910

The university's marine facilities are located both on the campus and at the Marine Laboratory. The Science building houses the classrooms and offices of members of the Department of Biology. The Marine Laboratory, contains office and research laboratory space for marine-related activites. The second increment--including a classroom, reference collection storage, laboratories and administration offices--should be completed by January 1974. Fourteen, 18 and 20-foot boats are available for offshore and reef studies. Major sea-water analytical equipment is available. The university publishes the journal "Micronesia" devoted to the natural sciences of Micronesia and related areas.

The following degree is offered:

M.S. in Biology--Although this M.S. degree is not specifically designed as a marine science-oriented program, the majority of students at the university work on some aspect of marine studies. Requirements: thirty credit hours in graduate-level studies, including six for thesis research; comprehensive oral examination; completion of master's thesis, and final oral examination on thesis research.

The following marine-oriented courses are offered in conjunction with the above program:

UNDERGRADUATE

BI 210	Oceanology	3

GRADUATE

BI 440	Icthyology	4
BI 510	Marine Bio-geography	2
BI 511	Marine Ecology	4
BI 530	Animal Behavior	4
BI 546	Marine Invertebrates	4
BI 547	Fisheries Biology	4
BI 574	Marine Botany	4
BI 691	Seminar	1
BI 695	Thesis Research	6

The instructional staff for the courses listed above consists of the following:

MARINE LABORATORY

Cheney, D. P., Ph.D., Assistant Professor
Eldridge, L. G., Ph.D., Chairman and Professor
Jones, R. S., Ph.D., Professor
Marsh, J. S., Ph.D., Assistant Professor
Randall, R. H., M.S., Instructor
Tsuda, R. T., Ph.D., Associate Professor
Yamaguchi, M., Ph.D., Visiting Professor

To obtain further information, address all inquiries directly to:

Dr. L.G. Eldridge
Director, Marine Laboratory
University of Guam
P.O. Box EK
Agana, Guam 96910

GULF COAST COMMUNITY COLLEGE
Panama City, Florida

Special facilities are housed in the Division of Mathematics and Science. A 12-acre site has recently been acquired with waterfront on a saltwater bay with deep and shallow areas as well as an island. The college also borders a large bay and has two freshwater lakes on the campus. Two laboratories are available to the Biology Department, but only one is used for marine biology. Plankton nets, beach nets, trawls, testing and sampling equipment, a large saltwater aquarium and a research vessel are available for collecting of specimen.

The following degrees are offered:

Associate of Science in Marine Technology. This is a two-year degree. Students have two options in the sophomore year: the physical option or the biological option. Students are encouraged to obtain practical field experience through internship courses for credit.

Associate of Arts in Pre-Oceanography. This program is intended to be preparation for transfer to and completion of a four-year program in oceanography. The student

is required to take chemistry (103-104), physics (201-202), algebra (MS105) and trigonometry (MS 110). It is recommended that the student take biology electives.

The following courses are offered in conjunction with the above programs:

BY	207	Marine Biology	3
OY	200	Ecology of the Sea	4
OY	202	Marine Laboratory Techniques	4
PSLS	113*	Physical Geology	3
PSLS	143	Fundamentals of Oceanography	3
PSLS	163*	Basic Physics	3
EG	101	Engineering Drawing	3
EG	112	D. C. Circuits	4
EG	243*	Mechanics	3
EG	241*	Surveying	4
EG	114*	A. C. Circuits	4
EG	213*	Electronic Problems	3

*Required in the physical option.

The instructional staff for the courses listed above consists of the following:

MATH-SCIENCE DIVISION

Brown, W. Joe, M. A. T., Associate Professor of Biology
Everett, Hayes L., M. Ed., Associate Professor of Physical Science
Henry, Cordell, Chairman, Math-Science Division
Masters, Dale, Assistant Professor of Biology
Traweek, James C., M. S., Assistant Professor of Chemistry

TECHNICAL AND SPECIALIZED DIVISION

Ashbrook, Joe, Assistant Professor of Drafting Design
Jones, Robert C., Associate Professor of Electronics
Wigfall, George, Assistant Professor of Drafting Design

To obtain further information, address all inquiries directly to:

Lester Morley
Dean of Career Studies
Gulf Coast Community College
Panama City, Florida 32401

GULF COAST RESEARCH LABORATORY
Ocean Springs, Mississippi 39564

The Gulf Coast Research Laboratory (GCRL) is a full-time marine research agency for the State of Mississippi and also offers education in the marine sciences at both the undergraduate and graduate levels.

Located on 40 acres on the coast of the north central Gulf of Mexico, the laboratory's physical facilities consist of modern well-equipped laboratories, and living accommodations for students. The six major buildings are of modern brick, glass and masonry construction and are air-conditioned. Facilities include dormitories to house 85 people and a dining hall to provide meals in summer.

A small fleet of boats owned by the laboratory includes the 65-foot research vessel R/V Gulf Researcher, the 40-foot trawl boat Hermes, nine power craft having 50 to 210 horsepower engines and ranging 17 to 30 feet in length, seven 14-foot wood skiffs and several aluminum boats under 14 feet in length.

Research equipment includes: Siemens II electron microscope; LKB ultrotome; atomic absorption spectrophotometer; IR spectrophotometer; gas chromatograph equipped for pesticides analysis; Zeiss Photomicroscope II; fully equipped photographic laboratory; total carbon analyzer; electrophoresis apparatus; fully equipped microbiology laboratory; microfilm reader - printer; salinometer; bathythermograph; S. T. D. profiler; XBT launcher, recorder and probes; T. S. K. current meter; specific ion meter; nansen bottles with reversing thermometers; Graf pen and tablet digitizer; and Warburg respirometer.

The laboratory is not a degree-granting institution but credit for courses completed is transferred to a student's home institution. Educational institutions affiliated with GCRL are: Alcorn A & M College, Belhaven College, Delta State College, Jackson State College, Millsaps College, Mississippi College, Mississippi State College for Women, Mississippi State University, Mississippi Valley State College, University of Mississippi, University of Southern Mississippi, William Carey College, Auburn University, Troy State University, Arkansas Polytechnic College, Wartburg College, Westmar College, Louisiana State University, McNeese State University, Northeast Louisiana University, Northwestern State University, Southeastern Louisiana University, Central Methodist College, Northwest Missouri State University, Southeast Missouri State College, Southwest Missouri State College, Queens College, Jamestown College, Bowling Green State University, Southwestern State College of Oklahoma, Coker College, Presbyterian College, Lambuth College, Memphis State University, Tennessee Technological University, Tennessee Wesleyan College, Union University, University of Tennessee at Nashville, and Southern Methodist University.

Some courses are offered only during the summer. Offered the year round are instruction and research programs leading to the M. S. and Ph. D. degrees in such areas as botany, ecology, microbiology, microscopy, morphology, parasitology, taxonomy, fisheries, biology, physiology, and zoology. The summer courses are:

UNDERGRADUATE

ZO	141	Introduction to Marine Zoology	4

UNDERGRADUATE OR GRADUATE

BOT	341	Marine Botany	4
GEO	331	Physical Marine Geology	3
GEO	332	Chemical Marine Geology	3
MIC	452	Marine Microbiology	5
ZO	361A	Marine Invertebrate Zoology I	6
ZO	361B	Marine Invertebrate Zoology II	6
ZO	362	Marine Invertebrate Zoology and Ichthyology	6
MS	400	Special Problems in Marine Science (undergraduate)	1-3
ZO	401	Problems in Advanced Histology	3-6
ZO	462	Parasites of Marine Animals	6
ZO	441	Marine Fisheries Biology	4
OCE	451	Introducation to Physical and Chemical Oceanography	5
ZO	463	Estuarine and Marsh Ecology	6

GRADUATE

ZO	530	Biological Electron Microscopy I	3
ZO	531	Biological Electron Microscopy II	3
OCE	541	Descriptive Physical Oceanography	4
MS	700	Special Problems in Marine Science (Graduate)	3-6
MS	800	Graduate Research (master's)	
MS	900	Graduate Research (doctor's)	

The instructional staff for the courses listed above consists of the following:

Buena S. Ballard, Ph. D.; Professor, Department of Biology, Southwestern State College of Oklahoma
R. B. Channell, Ph. D. ' Professor of Biology, Vanderbilt University

J. William Cliburn, Ph. D. ; Professor of Biology
University of Southern Mississippi
David W. Cook, Ph. D. ; Registrar and Head, Microbiology Section, Gulf Coast Research Laboratory
Charles K. Eleuterius, M. S. ; Head, Physical Oceanography Section, Gulf Coast Research Laboratory
Lionel N. Eleuterius, M. S. ; Head, Botany Section, Gulf Coast Research Laboratory
James J. Friauf, Ph. D.; Professor of Biology, Vanderbilt University
Gordon Gunter, Ph.D. ; Director Emeritus and Head, Physiology Section, Gulf Coast Research Laboratory
Harold D. Howse, Ph. D. ; Director and Electron Microscopist, Gulf Coast Research Laboratory
Thomas F. Lytle, Ph. D. ; Head, Analytical Chemistry Section; Gulf Coast Research Laboratory
M. Saeed Mulkana, Ph. D. Science Instructor, Jackson County Campus, Mississippi Gulf Coast Junior College and Research Associate, Gulf Coast Res. Laboaratory
Ervin G. Otvos, Ph. D. ; Head, Geology Section, Gulf Coast Research Laboratory
Robin M. Overstreet, Ph. D. ; Head, Parasitology Section, Gulf Coast Research Laboratory
Jesse O. Snowden, Jr., Ph. D. ; Associate Professor, Department of Earth Science, Louisiana State University in New Orleans

For information on degree programs offered by GCRL affiliates, contact the college or university directly. For further information on graduate research, the summer teaching program or laboratory facilities, write:

Registrar
Gulf Coast Research Laboratory
Ocean Springs, Mississippi 39564

HARVARD UNIVERSITY
Cambridge, Massachusetts 02138

The university maintains a cross-departmental Committee on Oceanography, but teaching and research in oceanography are carried out directly in the departments of the university devoted to the basic scientific field to which a particular branch of oceanography is related. The extensive laboratories of each of the science departments are available and equipped for work in almost all branches of physics, engineering and applied physics, applied mathematics, chemistry, geology and biology. The study collections in the botanical, zoological and geological museums are rich in marine material; especially valuable in these respects is the Museum of Comparative Zoology. Library facilities are extensive and the University Computer Center and Electronics Design Center are available for research related to oceanography

Of especial interest to graduate students in physical oceanography and geophysics is the Center for Earth and Planetary Physics, which consists of a group of faculty with common interest in the application of physical and mathematical methods to the investigation of large-scale natural phenomena of the earth and solar systems. Geophysics, atmospheric physics and oceanography are all represented in the center and interdisciplinary work is encouraged.

A fleet of sea-going ships and staff members experienced in the broad aspects of practical work at sea are available under the cooperative education program in oceanography between Harvard and the Woods Hole Oceanographic Institution. Under this program, qualified students registered for graduate work at Harvard or at the Woods Hole Oceanographic Institution have accesss as appropriate courses of instruction, advice of staff, and use of research facilities at the other institution.

Other oceanographic facilities and courses of instruction are available through cooperative agreements with the Massachusetts Institute of Technology, the Marine Biological Laboratory at Woods Hole, the Bermuda Biological Station for Research, and the Massachusetts Department of Conservation (Division of Marine Fisheries), the U.S. Fish and Wildlife Service, and other oceanographic institutions.

The Faculty of the Committee on Oceanography at Harvard University adheres to the principle that the oceanographer should be thoroughly qualified in one of the classical scientific disciplines. As a consequence, there is no department of oceanography at Harvard, but members of the Committee on Oceanography will assist students who wish to prepare themselves for work in this special field. At the undergraduate level, the student is expected to arrange courses within the framework provided in the usual fields of concentration. Graduate students will ordinarily meet the requirement for the higher degree within one of the existing divisions of the faculty, but if their programs necessarily bridge two or more established departments, their degrees may be administered by a joint committee composed of members of the departments concerned.

The following degrees are offered:

Biological Oceanography and Marine Biology. M.S. (or M.A.) and Ph.D., programs in the Department of Biology and Division of Engineering and Applied Physics. Master's per year, four; Ph.D.'s per year, two.

Chemical Oceanography and Marine Geochemistry. M.S. (M.A.) and Ph.D., programs in the Department of Geology and Division of Engineering and Applied Physics. Master's per year, two; Ph.D.'s per year, one.

Marine Geology and Geophysics. (M.S.), (M.A.) and Ph.D. in the Department of Geology and Geophysics. Master's per year, one; Ph.D.'s per year, one.

Physical Oceanography. (M.S.), (M.A.) and Ph.D. in the Division of Engineering and Applied Physics, Committee on Applied Mathematics, Department of Physics. Master's per year, three; Ph.D.'s per year, two.

Courses directly related to oceanographic sciences:

UNDERGRADUATE

NatSci 28	Prediction and Control of Atmospheres and Oceans
Biol 19	Ecology

UNDERGRADUATE/GRADUATE

Earth & Planetary Physics 102	Introduction to Physical Oceanography
Biol 133	Biology of Mollusks
Biol 140	Biology of the Algae
Biol 150	Population Molds
Biol 161	Environmental Physiology
Geol 147	Physical Sedimentary Processes
Geol 125	Chemical Oceanography

GRADUATE

Biol 254R	Species Diversity in Ecological Systems
Biol 161	Environmental Physiology
Eng 273	Water Pollution Microbiology
Eng 274	Chemical Models of Natural and Polluted Waters
Geol 252	Sedimentary Petrology and Geochemistry
Earth & Planetary Physics 201	Geophysical Fluid Dynamics
Earth & Planetary Physics 203	Energy Transfer in Atmospheres and Oceans
Earth & Planetary Physics 212	Special Topics in Geophysical Fluid Dynamics
Earth & Planetary Physics 216	Physical Oceanography

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Boss, K.J., Ph.D., Professor of Biology and Curator in Malacology
Bossert, W.H., Ph.D., Gordon McKay Professor of Applied Mathematics
Cohen, J.E., Ph.D., Associate Professor of Biology and Lecturer on Population Sciences
Crompton, A.E., Ph.D., Professor of Biology
Loeblich, A.R. III., Ph.D., Assistant Curator in the Farlow Herbarium
Schoener, T.W., Ph.D., Assistant Professor of Biology
Taylor, C.R., Ph.D., Associate Professor of Biology
Wilson, E.O., Ph.D., Professor of Biology

DEPARTMENT OF CHEMISTRY

Wilson, E.B., Ph.D., Theodore William Richards Professor of Chemistry

DIVISION OF ENGINEERING AND APPLIED PHYSICS

Baker, D.J., Ph.D., Associate Professor of Physical Oceanography
Butler, J.N., Ph.D., Gordon McKay Professor of Applied Chemistry
Carrier, G.F., Ph.D., T. Jefferson Coolidge Professor of Applied Mathematics
Fofonoff, N.P., Ph.D., Gordon McKay Professor of the Practice of Physical Oceanography
Goody, R.M., Ph.D., Mallinckrodt Professor of Planetary Physics
Mitchell, R., Ph.D., Gordon McKay Professor of Applied Biology
Robinson, A.R., Ph.D., Gordon McKay Professor of Geophysical Fluid Dynamics

DEPARTMENT OF GEOLOGICAL SCIENCES

Birch, F., Ph.D., Sturgis Hooper Professor of Geology
Holland, H.D., Ph.D., Professor of Geology
Siever, R., Ph.D., Professor of Geology

GRADUATE SCHOOL OF DESIGN

Smith, F.E., Ph.D., Professor of Advanced Environmental Studies in Resources and Ecology

SCHOOL OF PUBLIC HEALTH

Revelle, R.R., Ph.D., Richard Saltonstall Professor of Population Policy

To obtain further information, address all inquiries directly to:

Allan R. Robinson, Chairman
Committee on Oceanography
Pierce Hall
Harvard University
Cambridge, Massachusetts 02138

HIGHLINE COMMUNITY COLLEGE
Midway, Washington 98031

Highline offers a two-year (seven quarters) technical program to prepare students for employment as professional divers and technicians. The program provides the student with comprehensive training to permit him to work in an underwater environment when circumstances require and to operate effectively in the offshore oil or civil engineering construction industries.

The diving technician student begins instruction in the college's indoor swimming pool. He or she then progresses to open-water diving from the 200-foot college pier located on Puget Sound at nearby Redondo, diving year-round in open water from the pier facilities.

The student will gain diving experience with contemporary diving helmets, masks, gas recirculators and various types of scuba gear. A very thorough run is made on the complete control of a Wilson Mark IV Deep Diving system. This includes mixed gas, bell diving, console operations, and treatment operations from the recompression chamber.

In addition to instruction in diving, strong emphasis is placed on rigging, seamanship and piloting. Students also learn to operate a 10-ton crane that is part of the diving pier facilities. Along with seamanship, instruction includes ship construction, salvage principles and small boat handling. A course on blasting, with underwater application, is taught up to the level required for a state blaster's license. Students are required to obtain lifesaving and industrial first aid certification as part of the course.

The student will also receive instruction in engineering in well equipped shops, laboratories and classrooms. Other instruction includes welding and cutting above and below water, oceanography, communications, and mathematics.

Students must look beyond the glamour and excitement of the program to the realities of long hours of study, long hours of physical exertion and the potential hazards inherent in the undersea environment. Applicants for the program must complete a rigorous series of medical tests before they are admitted. Enrollment is limited to 50 students, and despite careful testing and screening, only 30 of that group can expect to complete the program. Students are required to carry health and accident insurance and to sign a liability waiver.

Successful completion of the following courses is required for award of the Associate of Applied Science degree in Marine Technology.

The following courses may be taken in any quarter of the first year, except MT 80 must be taken in the fall quarter of the freshman year. Students should plan to take 16 to 18 credits per quarter. All courses of the freshman year must be successfully completed before any sophomore year diving classes can be taken.

MT	80	Orientation	2
MT	90	Working Scuba	2
IT	51	Welding	5
IT	70	Construction	3
IT	80	Power Machinery	4
IT	35	Industrial First Aid	3
PE	130	Lifesaving	2
Engr	60	Technical Drawing	3
Engr	100	Fundamentals	3
Engr	110	Materials and Testing	4
Math	40	Industrial Math	5
Ocean	100	Oceanography	5
Engl	71	Communications	3
MT	71	Marlinspike Seamanship	2
MT	81	Diving Fundamentals	5
MT	72	Basic Rigging	2
MT	73	Salvage	2
MT	82	Hard Hat Diving	8
MT	83	Lt Weight Diving	8
MT	84	Underwater Wk	8
MT	85	Underwater Weld	8
MT	74	Blasting Techniques	2
MT	86	Diving Bell	8
MT	87	Mixed Gas Diving	8

Student college tuition and fees cover the cost of the program with the exception of lab fees and student's personal diving gear. At first, each student admitted to the program will be required to purchase only fins, mask.

and bathing suit. For the second year, students will be expected to purchase specified equipment which may cost as much as $250.

To obtain further information, address all inquiries directly to:

Program Coordinator
Diving Technician Program
Highline Community College
Midway, Washington 98031
Telephone: (206) TR 8-3710

UNIVERSITY OF HOUSTON
Houston, Texas 77004

Modern research facilities, including wet labs and cold storage, are available on the main campus in the Departments of Geology, Biophysics and Biology. Supplementary facilities, including a marine laboratory and fish tank, have been developed at the University of Houston Coastal Center, comprising 1,000 acres in the Galveston Bay area. Sea-going vessels are available by arrangement with Texas A & M University.

Marine sciences are taught in the Cullen College of Engineering and in the College of Arts and Sciences and in Bates College of Law. The university has an SDS Sigma 7 digital computing system available for qualified students and the Cullen College of Engineering is currently adding a large-scale modern hybrid computing facility for engineering research. In addition, the engineering school has acquired two large analog computing facilities from the General Electric Company and a large-scale digital computer ideal for instruction purposes from NASA. Students also have access to offshore drilling platforms of the oil industry.

The Cullen College of Engineering has recently moved into a new engineering building with adequate classroom and laboratory facilities for instruction in oceanography, ocean engineering and related fields. In the College of Arts and Sciences, the Department of Geology has about 26,50[illegible] square feet of space, Biophysics about 9,000 square feet, and Biology about 50,000 square feet.

The following degrees are offered:

M.S. or Ph.D. in Biology specializing in one of the following areas of marine biology: ecology, plant science, animal physiology, or microbiology. This program is experimentally oriented with the research programs emphasizing the estuaries and waters of the continental shelf.

The Master of Science and Doctor of Philosophy degrees with ocean engineering options are granted in chemical engineering, civil engineering, electrical engineering and mechanical engineering. In addition, Master of Science (Undifferentiated) and Doctor of Philosophy (Undifferentiated) degrees may be granted in interdisciplinary ocean engineering programs and in the College of Arts and Sciences.

A J.D. with emphasis in the marine field is offered by the Bates College of Law.

The requirements for these degrees are as follows:

Master of Science. Twenty-four or more semester hours of academic work are required in addition to a thesis which counts for a minimum of six semester hours. At least 12 semester hours, excluding the thesis, must be completed within the major field and, at the discretion of the department chairman, 18 semester hours may be required in the major field. No student may register for credit for more than 13 semester hours, exclusive of thesis and seminar, in any one semester.

The student must satisfactorily defend his thesis, prior to its acceptance, before a committee appointed by the department chairman and approved by the Dean of the Cullen College of Engineering.

The Doctor of Jurisprudence (J.D.) Degree shall be conferred on students who have met the following requirements: Completion, with six years for the date of matriculation, of 88 semester hours in law with a passing grade in each course; a weighted average of at least 65 for all law courses attempted, whether passed or failed; completion of all law courses designated as required. The student must have registered for, attended, and taken the final examination in all required courses; completion of a period of resident study equivalent to 27 months full-time or 36 months part-time; completion of the senior writing requirement by one of the following means: credit for a law seminar in which a paper is required or publication of one casenote and one comment or three casenotes in the Houston Law Review; in addition, the student is required to demonstrate proficiency in english composition. He may also be required to complete, under faculty supervision, written exercises such as monographs, legal briefs, and other works acceptable in form and content; and compliance with all other applicable requirements and with applicable regulations of the university and the Bates College of Law.

Each department offering a Ph.D. Degree has available a detailed description of its program and requirements, which may be obtained from the department chairman, that supplements the general requirements stated here:

Prerequisites are an M.A. or M.S. degree or the equivalent or 30 to 36 semester hours of graduate work in the appropriate field from a recognized institution and a minimum 3.0 (B) grade point average for all graduate work attempted.

The requirements are qualitative rather than quantitative, but will usually entail from two to four years of full-time study beyond the master's degree, depending on the student's area of specialization, level of training and experience. Required is: at least one academic year of full-time residence; competency in at least one foreign language; such qualifying, comprehensive and dissertation examinations as the department may specify; a minimum number of hours of course work and research over and bove the requirements for admission to the doctoral program but no less than 24 hours under any circumstances, and completion of a dissertation evidencing significant independent research.

The above requirements represent the minimum specified for all doctoral programs. Departmental requirements, taking cognizance of the specific needs of varying fields and professions, have been drawn up by the departmental faculties.

Foreign Language Requirement: Prior to admission to candidacy for a Ph.D. degree in programs within the College of Arts and Sciences, a student must demonstrate his competence in one foreign language acceptable to his department. Some departments may require competence in additional foreign languages or in mathematics or computer science.

The following requirements are specified for the Cullen College of Engineering: a minimum of 52 semester hours of approved graduate study beyond the master's degree, to include the following: major courses (7-10 semester hours), electives in related fields (12-15 semester hours), research and dissertation (20 semester hours); a minimum of two semesters and two summer sessions of residence in full-time graduate study; successful completion of written qualifying examinations; technical reading examination or approved academic training (six semester hours) in a modern foreign language (excluding the student's native language) pertinent to the individual research program or taking a minimum of six hours in an approved field other than his major or minor area; original research work, leading to a publishable contribution to engineering science, must be carried out under the direction of a faculty member and, upon completion, the candidate must defend the written dissertation in a final oral examination, and after completing the qualifying examination, the foreign language requirement, and 30 semester hours of the program, and with the approval of the department, the student will be admitted to candidacy.

The following courses are offered in conjunction with the above programs:

BIOLOGY

Bio 414A	Field Biology
Bio 414B	Field Biology
Bio 414C	Field Biology
Bio 426A	Ecological Methods
Bio 426B	Ecological Methods
Bio 436	Ecology
Bio 443	Comparative Animal Physiology
Bio 444	Invertebrate Zoology
Bio 444A	Marine Biology
Bio 448	Embryology
Bio 633	Marine Plants
Bio 633A	Physiology of Marine Bacteria
Bio 683A	Physiology of Marine Animals

GEOLOGY

Geo 380	Geology for Engineers
Geo 431	Earth Physics
Geo 438	Physical Oceanography
Geo 419	General Oceanography
Geo 631	Marine Geology
Geo 633	Nearshore Processes and Problems
Geo 667	Geochemistry I
Geo 668	Geochemistry II
Geo 680	Advanced Sedimentation
Geo 682	Sandstone Petrography
Geo 683	Carbonate Petrography
Geo 690	Quantitative Methods in Paleontology
Geo 691	Micropaleontology I
Geo 692	Biostratigraphy
Geo 693	Micropalentology II
Geo 694	Paleoecology
Geo 696	Stratigraphic Analysis
Geo 730	Principles of Gravity and Magnetic Exploration
Geo 731	Principles of Electrical and Radioactive Methods of Exploration
Geo 732	Principles of Seismic Exploration
Geo 733	Principles of Seismic Exploration II
Geo 734	Principles of Seismic Exploration III
Geo 735	Geophysical Interpretation

PHYSICS

Phy 330	Physical Meteorology
Phy 430	Dynamical Meteorology

BATES COLLEGE OF LAW

Law 520D	Legal Control of Marine Resources
Law 521F	Oil and Gas
Law 521Y	International Law
Law 573	Admiralty
	Seminar on Pollution

The Cullen College of Engineering has undergraduate programs in chemical, civil, electrical, industrial and mechanical engineering. In addition, these departments have graduate course offerings in many areas of special interest to ocean engineering. Some of the most significant of these courses in the Chemical Engineering Department are: (All courses numbered 600 and above are exclusively for graduate students.)

Che 530	Corrosion
Che 664	Flows through Porous Media
Che 731	Advanced Fluid Mechanics I
Che 733	Gas Dynamics II
Che 735	Advanced Fluid Mechanics II
Che 736	Advanced Fluid Mechanics III

The Department of Electrical Engineering also offers supporting course offerings for ocean engineering. Some of the most significant of the electrical engineering courses which are applicable to ocean engineering development include:

Ee 575A	Control Engineering
Ee 576A	Communication Theory
Ee 617	Propagation and Microwave Laboratory
Ee 618	Foundations of Analysis
Ee 631	Information Theory
Ee 633	Control System Design
Ee 637B	Advanced Electromagnetic Waves
Ee 663	Environmental Biotechnology
Ee 664	Systems Biotechnology
Ee 699	Ocean Engineering Instrumentation
Ee 690	Engineering Analysis I
Ee 691	Engineering Analysis II
Ee 737	Statistical Wave Propagation
Ee 739	Advanced Topics in Electromagnetic Theory

These courses are in addition to programs in electronics, control engineering, information theory, and hybrid computer applications.

The Mechanical Engineering Department offers courses in fluid mechanics, hydrodynamics and vibration analysis -- all of which are pertinent to an ocean engineering program. Some of the most significant courses currently being offered in mechanical engineering include:

Me 565	Vibration - Acoustical Transducers
Me 571	Vibration Analysis
Me 638	Aerothermodynamics
Me 660	Introduction to Advanced Dynamics
Me 661	Analytical Methods in Vibrations
Me 662	Advanced Dynamics
Me 665	Stress Waves in Continuous Media
Me 660	Mechanical Radiation
Me 690	Engineering Analysis I
Me 691	Engineering Analysis II
Me 731	Advanced Fluid Mechanics I - Laminar Flow
Me 732	Hydrodynamics I
Me 733	Gas Dynamics II
Me 734	Hydrody[illegible]
Me 735	Advanced Fluid Mechanics II - Turbulent Flow
Me 736	Advanced Fluid Mechanics III - Boundary Layer Flow
Me 739	Hydrodynamics of Waves
Me 760	Nonlinear Analysis

The Mechanical Engineering Department has a special emphasis on underwater acoustics, including underwater horn design and propagation characteristics.

Although ocean engineering is taught as an interdisciplinary program at the university, the primary responsibility for curricula development rests with the Department of Civil Engineering. The ocean engineering effort is aided by programs in environmental engineering, structures and soil mechanics. Principal courses which pertain to ocean engineering in the Civil Engineering Department include:

Ce 533	Evaluation of Water Quality in Natural Waters
Ce 573	Introduction to Ocean Engineering
Ce 582	Air Monitoring and Measurements
Ce 594	Water Monitoring and Measurements
Ce 630	Hydrodynamics I
Ce 631	Hydraulics of Open Channel Flow
Ce 639	Soil Dynamics
Ce 666	Oceanographic Aspects of Coastal Engineering
Ce 669	Ocean Engineering Instrumentation
Ce 681	Microclimatology
Ce 731	Hydrodynamics II
Ce 734	Hydraulic Transients
Ce 735	Hydrodynamics of Waves
Ce 761	Interaction of Soils and Structures

Ce 763	Design of Offshore Structures I
Ce 764	Design of Offshore Structures II

The instructional staff for the courses listed above includes the following:

BIOLOGY DEPARTMENT

Clark, Wallis H., Ph. D., Assistant Professor
Evans, John, Ph. D., Professor
Fotheringham, Nick, Ph. D., Assistant Professor
Jameson, David L., Ph. D., Professor
Lawrence, Addison L., Ph. D., Associate Professor
Mann, James E., Ph. D., Assistant Professor
Swallow, Richard L., Ph. D., Assistant Professor

GEOLOGY DEPARTMENT

Bishop, Margaret S., Ph. D., Professor
Chafetz, Henry S., Ph. D., Assistant Professor
Dobrin, Milton B., Ph. D., Professor
Lohse, E. Alan, Ph. D., Associate Professor
Maddocks, Rosalie, Ph. D., Assistant Professor
Van Sicien, DeWitt C., Ph. D., Professor

PHYSICS DEPARTMENT

Graves, Leon, S. M., Associate Professor

BATES COLLEGE OF LAW

Britton, Raymond L., LL. M., Professor
Ereli, Eliezer, Ph. D., Professor
Nixon, John LL. M., Professor
Newhouse, Thomas C., LL. M., Associate Professor

CULLEN COLLEGE OF ENGINEERING

Blumberg, Randolph, Ph. D., Associate Professor of Ocean Engineering
Castellanos, Leo John, M. E., Professor of Mechanical Engineering
Dalton, Charles, Ph. D., Associate Professor of Mechanical Engineering
Dukler, A. E., Professor of Chemical Engineering
Finch, Robert D., Ph. D., Associate Professor of Mechanical Engineering
Ghazzaly, Osman I., Ph. D., Assistant Professor of Civil Engineering
Hayre, Harbhajan S., D. Sc., Professor of Electrical Engineering
Hwang, Neddy H. C., Ph. D., Associate Professor of Civil Engineering

To obtain further information, address all inquiries directly to the dean of the appropriate college.

INDIANA UNIVERSITY
Bloomington, Indiana 47401

Specialized facilities, all of which are located at the Bloomington campus of the university, include laboratory facilities in the Department of Geology for study of marine sedimentology, ecology and geo-chemistry; sampling equipment for collecting bottom sediments; gear for shallow underwater work and laboratory facilities in the Department of Zoology for the study of aquatic organisms.

No degree at Indiana University is specifically designated marine science or oceanography; nor, for that matter, are other specialities in geology and zoology the basis for separately named degrees. The A. B., B. S., A. M., and Ph. D. degrees are offered in Geology, and the student may train for specialization in marine geology within both the A. M. and Ph. D. degrees. The Department of Zoology offers the A. B., B. S., A. M. and Ph. D. degrees, and the student may direct concentration toward marine zoology at the A. M. and Ph. D. levels.

A. M. degree requirements: the candidate may elect to write a thesis, demonstrate reading knowledge of one foreign language, or acquire (without graduate credit) a specialized research skill applicable to his or her need, and must complete 30 semester hours of acceptable graduate credit with a minimum grade average of B.

Geology Ph. D. requirements: the candidate must complete at least 90 hours of advanced course study, and meet one of the following two requirements: demonstrate reading proficiency in one foreign language; acquire (without graduate credit) a specialized research skill applicable to his or her need.

Zoology Ph. D. requirements: the candidate must complete at least 90 hours of advanced course study, and meet one of the following requirements: demonstrate reading knowledge of two foreign languages; demonstrate proficiency in depth in one foreign language; demonstrate reading knowledge of one foreign language and acquire (without graduate credit) a research skill applicable to his need and acquire (without graduate credit) two research skills applicable to his or her need.

There are no specific course requirements for any of the A. M. or Ph. D. degrees mentioned. During the past academic year, no degrees were awarded to either the A. M. or Ph. D. levels with a specialization in marine zoology or marine geology.

The following courses are offered in conjunction with the above programs:

GRADUATE

DEPARTMENT OF GEOLOGY

G 526	Oceanography	3
G 527	Geological Oceanography	3
G 575	Geology of Shallow Marine Environments	3-6

DEPARTMENT OF PLANT SCIENCES

B 340	Algae	5
B 583	Algae and Fungi	5

DEPARTMENT OF ZOOLOGY

Z 374	Invertebrate Zoology	5
Z 406	Vertebrate Zoology	5
Z 468	Limnology	4
Z 571	Production Limnology	3
Z 572	Biology of Fish Populations	3
Z 578	Advanced Population Ecology	2

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF GEOLOGY

Dood, J. R., Ph. D. Associate Professor
Hattin, D. E., Ph. D., Professor

DEPARTMENT OF PLANT SCIENCES

Starr, R. C., Ph. D., Professor

DEPARTMENT OF ZOOLOGY

Crowell, P. S., Ph. D., Professor
Emlen, J. M., Ph. D., Associate Professor
Frey, D. G., Ph. D., Professor
Nelson, C. E., Ph. D., Associate Professor

To obtain further information address all inquiries directly to:

Professor J. Robert Dodd
Department of Geology
Indiana University
1005 East Tenth Street
Bloomington, Indiana 47401

THE JOHNS HOPKINS UNIVERSITY
Baltimore, Maryland 21218

Macaulay Hall offers adequate office, laboratory and shop space for all branches of the oceanographic program. Other experimental facilities are available in Maryland and Latrobe Halls. The laboratories are equipped with the general and specialized equipment required for oceanographic research. Photographic, drafting and data reduction facilities are available to students; an extensive and active Computer Center is maintained on the campus.

In addition, the resources of the Chesapeake Bay Institute, a division of the university engaged in oceanographic contract research, are available to students in the Department of Earth and Planetary Sciences. The CBI research vessels are docked at the institute's field laboratory in Annapolis, Md., about an hour's drive from the campus. The 106-foot catamaran R/V Ridgely Warfield, is the largest of the institute's vessels, specifically designed for research in estuarine and coastal waters. The 70-foot R/V Maury and several smaller vessels are included in the fleet. A large barge is available for long-term, on-station studies. Included in the institute is an engineering design group for the development of new oceanographic instruments.

The Department of Earth and Planetary Sciences has an agreement with the Smithsonian Institution in Washington, D.C., which permits students to use its facilities should this be required for their research.

The department will accept candidates for either an M.A. or Ph.D. program. Candidates for the M.A. in oceanography must complete a prescribed program of course work in oceanography, demonstrate a reading knowledge in french, german or russian, complete an essay based on original work, and pass an oral examination before a committee of the department.

Candidates for the Ph.D. will take such courses and meet such requirements as deemed necessary by their advisory committee, must satisfy the foreign language requirements of the department, must pass a comprehensive examination prepared by an appropriate departmental committee and pass the oral examination administered by the Graduate Board of the university, and submit an acceptable dissertation based on original research. A year of residence at the university is required for all advanced degrees.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

11-12	Introduction to the Earth Sciences	3
321	Oceanography	3
331	Introduction to Marine Ecology	3
332	Marine Plankton Ecology	
378	Introduction to Geochemistry	3
395	Mathematical Methods in Applied Sciences	3

GRADUATE

601-602	Seminar in Oceanography	1
607-608	Research	--
609-610	Special Topics in Earth and Planetary Sciences	--
611	Physical Oceanography	5
612	Dynamical Oceanography	3
613	Ocean Waves	3
614	Atmospheric and Oceanic Turbulence	3
617-618	Geophysical Fluid Mechanics	3
620	Estuarine Oceanography	2
622	Analysis of Serial Oceanographic Data	1
624	Marine Geochemistry	3
625	Advanced Chemical Oceanography	3
628-629	Chemistry of Aqueous Solutions	3
631	Topics in Marine Ecology	--
632	Marine Plankton Ecology	3
633	Marine Paleoecology	2
637	Marine Benthic Ecology	2
638	Ecology of Aquatic Benthos	4
639	Ecology of Coral Reefs	3
670	Marine Geology	3
673-674	Seminar in Geophysical Fluid Dynamics and Turbulence	1.5
685-686	Geochemistry	3
698	Topics in Geochemistry	1

The instructional staff for the courses listed above consists of the following:

Benton, G.S., Ph.D., Vice President of the University and Professor of Dynamical Meteorology
Bretherton, F.P., Ph.D., Professor of Meteorology and Oceanography
Bricker, O.P., Ph.D., Associate Professor of Geology
Brush, L.M., Ph.D., Professor of Sedimentation
Cloos, E., Ph.D., Professor Emeritus of Structural Geology
Elliott, D.W., Associate Professor of Structural Geology
Eugster, H.P., Ph.D., Director of Graduate Admissions and Professor of Geology
Fisher, G.W., Ph.D., Associate Professor of Geology
Hacker, P., Ph.D., Assistant Professor of Physical Oceanography
Hardie, L.A., Ph.D., Associate Professor of Geology
Hunt, C.B., Professor of Geology
Jackson, J.B.C., Ph.D., Assistant Professor Marine Ecology
Lafon, G.M., Ph.D., Assistant Professor of Chemical Oceanography
Long, R.R., Ph.D., Professor of Fluid Mechanics
Marcus, A.H., Ph.D., Associate Professor of Statistics
Montgomery, R.B., Sc.D., Professor of Oceanography
Pettijohn, F.J., Ph.D., Professor of Geology
Phillips, O.M., Ph.D., Chairman and Professor of Geophysics
Pritchard, D.W., Ph.D., Director of Chesapeake Bay Institute and Professor of Oceanography
Scott, W.E., Ph.D., Assistant Professor of Geo-Physical Fluid Dynamics
Stanley, S.M., Ph.D., Associate Professor of Paleobiology
Strickler, J.R., Ph.D., Assistant Professor of Biological Oceanography
Taylor, W.R., Ph.D., Associate Professor of Biological Oceanography

LAMAR UNIVERSITY
Beaumont, Texas 77710

Lamar University has oceanographic science research and teaching facilities at its main campus located at Beaumont, Texas and a field-teaching research facility located at Pleasure Island, Texas, adjacent to Sabine Lake, a shallow water estuary of the Gulf of Mexico.

Most of the field activity is related to coastal environmental problems and are centered at the 40,000 square foot Pleasure Island facility where geological, biological and geochemical laboratories are presently being established. Berthing facilities lie adjacent to the Pleasure Island laboratory where the 34-foot twin engined, steel catamara, 20-foot glass inboard-outboard, and 23-foot twin outboard boats are kept. Smaller glass boats and aluminum skiffs are also available for river and shallow bay collection.

The 34-foot catamaran is rigged for shallow water coring, trawling, and dredging. Research equipment includes an induction salinometer, dissolved oxygen meter, Ekman current meter, otter and plankton trawl nets, pH meters, atomic absorption spectrometer, x-ray diffraction, microscopes and photographic equipment.

The following degrees are offered:

The Oceanographic Technology degree program has recently been revised and is now entitled Oceanographic Sciences. Biology, geology, engineering and technological options are offered within the Oceanographic Science, Bachelor or Science degree program.

The following undergraduate courses are offered in the biology, geology and engineering program:

Bio	346	Invertebrate Zoology
Bio	443	Limnology
Bio	445	Marine Biology
Bio	449	Protistology
CE	331	Environmental Science
CE	339	Soils Science
EE	438	Instrumentation
Egr	233	Circuits and Fields
Geo	337	Meteorology
Geo	338	Oceanography - Earth Science
Geo	344	General Oceanography
Geo	361	Estuarine Processes - Summer
Geo	421	Physical Oceanography
Geo	423	Shipboard Operations
Geo	438	Geophysics

The two-year technological program is a cooperative effort with Brazosport Junior College and includes the following courses:

CS	131	Computer Introduction
DM	131	Introduction to Diesel Engines
DM	133	Small Engines
DM	136	Basic Shop Procedures
Egr	233	Circuits and Fields
IEE	133	Basic Electricity
OC	104	Seamanship (Brazosport campus)
OC	106	Oceanic-Marine Technology (Brazosport)
OC	123	Marine Engineering (Brazosport)
OC	124	Navigation (Brazosport)
MT	133	Machine Shop
Wld	133	Welding

The instructional staff for the courses listed consists of the following:

BIOLOGY

Harrell, Richard C., Ph.D., Assistant Professor
McGraw, J. Leon, Ph.D., Assistant Professor
Robertson, Phillip B., Ph.D., Assistant Professor

ENGINEERING

Beale, Luther A., Ph.D., Professor
Cherry, Lloyd B., P.E., Professor
Crum, Floyd M., Professor
Delflache, Andre P., Ph.D., Professor
Morgan, William E., Ph.D., Instructor

GEOLOGY

Estes, Ernest, Ph.D., Associate Professor
Matthews, William (Earth Science), Professor
Pampe, William, Ph.D., Associate Professor
Scrudato, R.J., Ph.D., Assistant Professor
Snyder, P.B., Ph.D., (Earth Science), Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. H.E. Eveland, Director
Department of Geology
Lamar University, Box 10031
Beaumont, Texas 77710

LEHIGH UNIVERSITY
Bethlehem, Pennsylvania 18015

The Center for Marine and Environmental Studies (CMES) was established in 1962 as an interdepartmental research organization to assist in providing research opportunities for faculty and graduate students in marine science, ocean engineering and environmental studies. The facilities on campus include four divisions. The Marine Biochemistry Laboratory is equipped for microbiological and biochemical research on marine bacteria. The Marine Biology Laboratory is equipped with temperature-controlled artificial seawater aquaria for research in marine ecology and marine pollution. The Marine Geotechnical Laboratory is a well-equipped facility for geotechnical ocean engineering, with specialized apparatus for measuring significant engineering and mass physical and chemical properties of sea-floor soils both in the laboratory and in place at sea from surface ships and manned submersibles. The Institute for Pathobiology is equipped to study abnormal and diseased conditions of marine invertebrates, fish and plants. The normal facilities of the Departments of Biology, Chemistry, Geological Sciences and Civil Engineering are also available for marine-oriented research.

The university also operates an off-campus facility, the South Jersey Wetlands Institute, near Stone Harbor, New Jersey, on the Atlantic Coast. Summer courses are taught here, and research on coastal salt marsh ecology is carried out year-round. The institute is equipped with a flowing seawater system, several outboard boats, standard collecting gear, and the usual laboratory research instruments.

No degrees specifically designated as marine science or oceanography are offered. Course work and thesis or dissertation research can be marine-oriented for the M.S. and Ph.D. degrees in the academic Departments of Biology, Chemistry, Geological Sciences, Physics, Civil Engineering and Mechanical Engineering and Mechanics. Degree requirements vary among the departments. The minimum program for the master's degree is 30 semester hours of graduate work, at least 18 hours in the major field of which 15 hours must be "400" level courses, and a thesis or report based on a research course. The required program of courses is planned with the approval of the department chairman. A comprehensive examination may be required by the major department.

A candidate is admitted to the Ph.D. program in any of the above departments after passing a qualifying examination to demonstrate general proficiency in his major field. A minimum of two years post-master's work (60 credits)

is required, of which a major portion may be dissertation research. The course and research program is formulated by the candidate and his special committee. Foreign language requirements are the option of the major department. The cadidate is required to present a dissertation based on research under the general direction of a professor at Lehigh University. The dissertation shall treat a topic related to the candidate's major subject, embody the results of original research, and constitute a contribution to knowledge. An oral examination on the dissertation is required.

Approximately ten M.S. and four Ph.D. degrees in marine-related aspects of traditional science and engineering disciplines were awarded in the past academic year.

The following courses are offered in conjunction with the above programs:

GRADUATE

Bio	417	Marine Ecology	3
Bio	418	Biological Oceanography	3
Bio	480	Marine Science Seminar	1
CE	425	Mechanics of Sediment Transport	3
CE	431	Geotechnical Ocean Engineering	3
CE	439	Ocean Engineering Research	1-6
Geo	461	Marine Geology	3

A wide variety of other courses, both undergraduate and graduate, are offered by various departments to provide the basic skills required for research in the marine sciences and ocean engineering. Special topics and research courses are offered in each department.

The instructional staff for the courses listed above consists of the following:

BIOLOGY DEPARTMENT

Herman, Sidney S., Ph.D., Professor

CHEMISTRY DEPARTMENT

Hulbert, Matthew H., Ph.D., Assistant Professor

CIVIL ENGINEERING DEPARTMENT

Graf, Walter H., Ph.D., Associate Professor
Hirst, Terence J., Ph.D., Associate Professor
Richards, Adrian F., Ph.D., Professor of Oceanography and Ocean Engineering

GEOLOGICAL SCIENCES DEPARTMENT

Carson, Bobb, Ph.D., Assistant Professor

MECHANICAL ENGINEERING AND MECHANICS DEPARTMENT

Stenning, Alan H., Sc.D., Professor

PHYSICS DEPARTMENT

Van Sciver, Wesley J., Ph.D., Professor

To obtain further information, address all inquiries to the chairman of the academic department in which the graduate degree is desired:

Lehigh University
Bethlehem, Pennsylvania 18015

LONG ISLAND UNIVERSITY/SOUTHAMPTON COLLEGE
Southampton, New York 11968

The Division of Natural Sciences instructional, laboratory and research space approximates 21,500 square feet which includes a one-acre campus marine station of 4,500 square feet with dockside facilities. Vessels owned and operated by the division include the Shawna IV, a 36-foot twin diesel research vessel which is equipped with radar, loran, recording fathometer, s/s and CB radio, electrically driven one-ton capacity hydrographic winch with 1,000 feet of wire and a small wet laboratory. Additional research vessels include two 24-foot pontoon platform outboard powered vessels; one 20-foot sea skiff; one 19-foot and one 17-foot fiberglass utility boat. These five vessels are equipped with winch, davit or A-frame and metering wheel, fathometers, and specialized sampling and collecting equipment as required for shallow water and estuarine work. Major marine laboratory instruments available include a three-channel technician auto-analyzer a multichannel scintillation spectrophotometer, atomic furnace absorption spectrophotometer, anodic stripper, gas chromatography apparatus, X-ray crystallography apparatus, a salinometer, and a sediment size analyzer.

The Bachelor of Science or Bachelor of Art in Marine Science is offered with concentrations in biological, chemical or geological areas of study. All marine science majors must take the following courses as prerequisites: Math 106, 201, 202 (college math through calculus); Physics 201-202, and Chemistry 101-102 (general), 201 (quantitative analysis).

All marine science majors must take the marine science sequence MS309, MS310, MS390-391.

All majors must select one area of concentration from:

a) Biological: Bio 101 and one from Bio 102-106 or Geol 101, or Geol 119; Bio 211 (genetics), Chem 203 (organic), MS 341, two from Bio 201, 203 or 221, and two from Bio 206, 207, 208, 210, 216, 314, 320 and 342.
b) Chemical: Chem 101-102 or Chem 111-112; 201; 202; 203-204; 301-302; 304; MS 310; Geol 302 Geochemistry.
c) Geological: Geol 113-114; 115; 119; one from 201, 207 or 302; 205; 321, MS338.

The number of marine science majors graduating in 1972-73 was 40. In addition to the above programs, an environmental science major is offered which combines training in a specific discipline and broad exposure to the social science aspects of environmental problems.

The following courses are offered in conjunction with the above programs:

Marine Science Department

MS	107	Meteorology	4
MS	111	Introduction to Oceanography	4
MS	222	Fisheries Biology	4
MS	309	Physical Oceanography	4
MS	310	Chemical Oceanography	4
MS	311	Primary Productivity	4
MS	338	Marine Geology	4
MS	341	Marine Ecology	4
MS	390-391	Marine Operations & Research	6
MS	393	Independent Study	1-4

Biology Department

Bio	101	Cell Biology	4
Bio	102	Plant Biology	4
Bio	103	Animal Biology	4
Bio	104	Human Biology	4
Bio	105	Field Biology	4
Bio	201	Marine Phycology	4

Bio	203	Invertebrate Zoology	4
Bio	206	Physiology	4
Bio	207	Endocrinology	4
Bio	208	Developmental Biology	4
Bio	210	Microbiology	4
Bio	211	Genetics	4
Bio	216	Parasitology	4
Bio	221	Ichthyology	4
Bio	314	Biochemistry	4
Bio	320	Evolution	4
Bio	342	Ethology	4

Chemistry Department

Chem	101-102	General Chemistry	4-4
Chem	111-112	Advanced General Chemistry	4-4
Chem	201	Quantitative Analysis	4
Chem	202	Instrumental Analysis	4
Chem	203-204	Organic Chemistry	4-4
Chem	301-302	Physical Chemistry	4-4
Chem	304	Advanced Inorganic Chemistry	4
MS	310	Chemical Oceanography	4

Geology Department

Geol	101	Introduction to Geology	4
Geol	113-114	Mineralogy	4-4
Geol	115	Stratigraphy and Sedimentation	4
Geol	119	Paleoecology	4
Geol	201	Petrology	4
Geol	205	Field and Structure	4
Geol	207	Coastal Processes	4
Geol	220	Field Geology	4-6
Geol	302	Geochemistry	4
Geol	321	Geosynclines and Global Tectonics	4
MS	338	Marine Geology	4

The instructional staff for the courses listed above consists of the following:

DIVISION OF NATURAL RESOURCES

Achuthan, Radh, M.S., Assistant Professor of Physics
Andrews, John W., Ph.D., Assistant Professor of Physics
Badzinski, Stanley R., B.S., Instructor of Biology
Barnes, Steven S., Ph.D., Assistant Professor of Chemistry and Marine Science
Bane, Gilbert W., Ph.D., Associate Professor of Biology and Marine Science
Berkebile, C. Alan, Ph.D., Associate Professor of Geology and Marine Science
Briles, George, Ph.D., Associate Professor of Chemistry
Burke, William T., Ph.D., Professor of Biology and Director of Division
Coher, Edward I., Ph.D., Associate Professor of Biology and Marine Science, New York Ocean Science Laboratory
Collins, John, Marine Operations
Danziger, Robert, Ph.D., Assistant Professor of Chemistry
Duberman, Daniel, D.V.M., Associate Professor of Biology
Getz, Donald, B.A., Assistant Marine Station Manager
Haresign, Thomas, Ph.D., Associate Professor of Biology
Hehre, Edward, Ph.D., Assistant Professor of Biology and Marine Science
McCormick, C.L., Ph.D., Assistant Professor of Geology and Marine Science
Melter, Robert, Ph.D., Associate Professor of Mathematics
Reisman, Howard M., Ph.D., Assistant Professor of Biology and Marine Science
Siegel, Alvin, Ph.D., Professor of Chemistry and Marine Science
Shannon, Richard, Ph.D., Assistant Professor of Mathematics
Smith, Arthur E., M.Ed., Assistant Professor of Mathematics
Stevens, Nathaniel H., M.S., Associate Professor of Mathematics
Thatcher, M. Llewellyn, Ph.D., Assistant Professor of Marine Science
Welker, J.R., M.S., Associate Professor of Biology and Marine Science

ADJUNCT FACULTY

Delihas, Nicholas, Ph.D., Professor of Biology
Hahn, Steven, B.S., Associate Professor of Marine Electronics and Instrumentation
Hitchcock, Anthony, M.S., Assistant Professor of Biology
Price, Jessie, Ph.D., Associate Professor of Biology

To obtain further information, address all inquiries directly to:

Dr. Alvin Siegel, Director
Marine Science Program
Southampton College
Southampton, New York 11968

LOUISIANA STATE UNIVERSITY
Baton Rouge, Louisiana 70803

Marine sciences education at L.S.U. is focused on the study, management and development of marshlands, estuaries, shallow-water environments and related resources typical of the coastal zone. The department and cooperating university organizations provide extensive aerial photographic and map collections, nuclear and computer science facilities, chemical analysis capabilities, biological and sedimentological laboratories and sampling equipment, boats and skiffs for nearshore operations, machine shops, photographic laboratories and library facilities.

Field operations in Louisiana are conducted from university-leased facilities on Grand Isle or from those provided through cooperation with the extensive marshland refuge system operated by the Louisiana Wild Life and Fisheries Commission. The operations base at Grand Isle includes living space for eight to ten people and a portable laboratory building. A smaller, float-mounted laboratory is available for on-site work in the marsh and estuaries. Although larger boats can be berthed at nearby marinas, most field work is conducted with boats in the 16- to 24-foot class and small skiffs.

The Center for Wetland Resources at L.S.U. serves as the university's primary agency for research and education in the marine and wetland fields. The center was founded in 1970 and it brought together three of the university's marine-oriented agencies: Coastal Studies Institute (CSI), Department of Marine Sciences, and Office of Sea Grant Development. In addition to its own education, research and advisory services, the center is committed to the encouragement and support of activities related to the wetlands theme throughout the university and state.

The Department of Marine Sciences, created in 1968, has developed master's and doctoral programs for students interested in careers involving marine-related research, technology, resource utilization and education. Although a few of the department's courses are open to undergraduates, no baccalaureate degree program is offered. Courses and curricula in the department are concerned mainly with the marsh and shallow-water environments of the Louisiana coast rather than the "bluewater" courses stressed elsewhere. The academic program is augmented by a wide choice of marine-related courses taught in other departments of the university. Several CSI and OSGD personnel serve as faculty members of the Department of Marine Sciences.

The Office of Sea Grant Development administers funds granted to the university by the Office of Sea Grant of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Functions include program development, budgetary management and technical review of the separate projects which comprise L.S.U.'s Sea Grant program, and promotion of Sea Grant objectives throughout the university and state. The latter activities denote an important advisory role in working with state agencies and assuring public awareness concerning the need for new knowledge and social institutions to cope with coastal zone problems in the state.

1. M.S. in Marine Sciences. In conjunction with the requirements and scheduling specified in the current issue of the university bulletin, the degree requires:

a. A program of study approved by the department chairman and the student's major professor. The program will normally consist of a minimum of 24 hours of graduate-level courses and six hours of thesis research. Courses will usually include two core courses or equivalents and at least two 200-level courses. In addition, at the request of the major professor, a proficiency in mathematics 57 may be required of students in certain programs. The remaining electives may be chosen with the consent of the student's major professor from other appropriate courses in the Department of Marine Sciences or other departments.

Research culminating in the preparation of an acceptable master's thesis should demonstrate the capacity for originality of thought, research and facility in organizing material.

b. An average grade not lower than B and no grade lower than C in the courses offered for the degree.

c. Passing a final oral examination based largely on the student's area of specialization, aspects of his research problem and past course work.

d. Although a reading knowledge of a foreign language is not required of a candidate for the master's degree, the major professor may recommend some exposure to a particular language if a large body of foreign-language literature exists in the candidates's specialty field. In some specialty fields, recommendations may be made to develop the student's proficiency in statistics, computer sciences, etc., rather than in a foreign language.

2. Ph.D. in Marine Sciences. In conjunction with the requirements and scheduling specified in the current issue of the university bulletin, this degree requires:

a. A program of study approved by the student's major professor and advisory committee consisting of (a) at least 48 hours of course work beyond the baccalaureate. (Course work will normally include several core courses or their equivalents plus a minimum of 12 hours of appropriate 200-level courses in the department. In addition, the student must select a minor in another department--or an internal minor approved by the graduate council. The remaining electives may be selected from other courses designed to complete the student's program of study.) (b) A maximum of 12 hours of research leading to a dissertation in some area of marine science.

b. An average grade not lower than B and no grade lower than C in the courses offered for the degree.

c. A reading knowledge of at least one language other than his native language. The language is to be selected from the following: german, russian, french, spanish and english. The candidate's selection should be based upon the abundance of foreign-language scientific literature in his field of specialization. The language requirement must be met prior to scheduling the general examination.

d. Passing a comprehensive written and oral qualifying examination covering the student's scientific background and training, course work and general capabilities in the scientific field. This examination should be taken during the first semester after the master's degree is awarded or after one year of graduate study for students not taking the master's degree.

e. Passing a comprehensive general examination consisting of written and oral portions in a manner that conclusively demonstrates the student's competence over broad segments of marine sciences and a high degree of familiarity with current progress in one or more minor fields.

f. Passing an oral final examination based on the dissertation research.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF MARINE SCIENCES

126	Chemical Oceanography	3
160	Introduction to Marine Sciences for Graduate Students	3
164	Marine Resources Law	3
165	Chemistry and Microbiology of Flooded Soils and Sediments	2
167	Marine and Wetland Ecology for Teachers	3
168	Marine and Wetland Ecology for Teachers	3
170	Physical Oceanography	3
171	Coastal and Marine Meteorology	3
172	Estuarine Ecology	3
209	Coastal Swamps and Marshes	3
222	Gravity Waves in Shallow Water	3
223	Shore Dynamics	3
225	Estuarine and Shallow-Water Oceanography	3
231	Geochemistry of Coastal Water, Soils and Sediments	3
232	Coastal Physical/ Chemical Systems: Analytical Methods	3
241	Coastal Ecology	3
242	Coastal Climatology,	3
246	Coastal and Estuarine Resources	3
350A	Advanced Reading and Literature Research	3-6
350B	Advanced Field Research	3-6
300	Thesis Research	1-6
400	Dissertation Research	1-9

DEPARTMENT OF BOTANY

138	Plant Ecology
203	Mineral Nutrition of Plants
205	Mineral Nutrition of Plants Laboratory

DEPARTMENT OF CHEMICAL ENGINEERING

101	Transport Science: Momentum Transfer
102	Transport Science: Heat and Mass Transfer
194	Ecosystems Analysis
276	Mathematical Analysis of Natural Systems
295	Application of Transport Phenomena in Ecological Systems Modeling

DEPARTMENT OF CIVIL ENGINEERING

HYDRAULIC ENGINEERING

162	Fluid Mechanics
163	Hydraulics
165	Hydrology
203	Free Surface Flow
206	Advanced Hydraulics
280	Advanced Hydrology
290	Optimization Techniques in the Planning, Design and Operation of Water Resources Systems

ENGINEERING

111 Environmental Engineering

ENGINEERING SCIENCE

193 Ocean and Coastal Engineering
210 Materials for Marine Environments

DEPARTMENT OF EXPERIMENTAL STATISTICS

201 Basic Statistical Methods
202 Advanced Statistical Methods
206 Principles of Experimental Design

DEPARTMENT OF FOOD SCIENCE

101 Food Process Engineering
143 Food Technology I
144 Food Technology II
170 Food and Drug Laws, Standards and Regulations
175 Food Preservation
182 Plant Metabolism
186 Marine Food Resources and Technology
230 Advanced Food Research - Marine Food Products
271 Seminar in Food Science
272 Seminar in Food Technology

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT

WILDLIFE AND FISHERIES

124 Fur Animal Management
125 Limnology
126 Fundamentals of Fish Culture
157 Special Problems
225 Advanced Game Management - Waterfowl
230 Fish Parasites and Diseases
232 Fishery Research Techniques
236 Water Pollution Biology
238 Fisheries Hydrography
239 Shellfisheries Biology
240 Mariculture

SCHOOL OF GEOSCIENCES

GEOGRAPHY AND ANTHROPOLOGY

101 Geography of Louisiana
113 Meteorology
114 Climatology
115 Microclimatology
119 Aerial Photo Interpretation I
120 Aerial Photo Interpretation II
121 Alluvial Geomorphology
123 Coastal Morphology
128 Marine and Coastal Environments: Natural
129 Marine and Coastal Environments: Cultural
260 Hydroclimatology

GEOLOGY

124 Deltaic Geology
131 Introductory Sedimentology and Stratigraphy
142 Introductory Geophysics
159 Introductory Geochemistry
232 Dynamics of Sedimentation
233 Sedimentary Petrology of Carbonates
234 Clay Mineralogy
251 Paleoecology
256 Oceanographic Geochemistry
259 Low-Temperature Physical Geochemistry
260 Advanced Topics in Geochemistry

DEPARTMENT OF HOME ECONOMICS

123 Human Nutrition

DEPARTMENT OF MICROBIOLOGY

161 Microbiology of Water, Sewage and Industrial Wastes
200 Electron Microscopy of Biological Materials
221 Virology

NUCLEAR SCIENCE CENTER

101 Radioisotope Techniques
201 Advanced Tracer Methodology for Biological Sciences

DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

145 Ichthyology
147 Marine Vertebrate Zoology
153 Animal Ecology
171 Marine Invertebrate Zoology, Part I
172 Marine Invertebrate Zoology, Part II
236 Seminar in Ecology
237 Seminar in Ecology
238 Seminar in Systematics, Evolution and Zoogeography
239 Seminar in Systematics, Evolution and Zoogeography

The instructional staff for the courses listed above includes the following:

DEPARTMENT OF MARINE SCIENCES

Coleman, James M., Ph.D., Associate Professor
Day, John W., Jr., Ph.D., Assistant Professor
Ford, Ted B., Ph.D., Professor
Gagliano, S.M., Ph.D., Associate Professor
Gosselink, James G., Associate Professor
Ho, Clara L., Ph.D., Associate Professor
Hsu, Shih-Ang, Ph.D., Assistant Professor
Loesch, Harold C., Ph.D., Professor
McIntire, William G., Ph.D., Professor
Pope, Robert M., B.S., Instructor
Roberts, Harry H., Ph.D., Assistant Professor
Schweitzer, James P., Ed.D., Assistant Professor
Smith, W.G., Ph.D., Assistant Professor
Sonu, Choule J., Ph.D., Professor
Stone, James H., Ph.D., Associate Professor
Suhayda, Joseph N., Ph.D., Assistant Professor
van Beek, Johannes, L., M.S., Assistant Professor
Van Lopik, Jack R., Ph.D., Chairman and Professor
Whelan, Thomas, III, Ph.D., Assistant Professor
Wiseman, Wm. J. (Jr), Ph.D., Assistant Professor
Wright, L.D., Ph.D., Assistant Professor

AGRONOMY

Patrick, William H., Jr., Ph.D., Professor

DEPARTMENT OF BIOCHEMISTRY

Allen, R. Scott, Ph.D., Head and Professor

DEPARTMENT OF CHEMICAL ENGINEERING

Pike, Ralph W., Ph.D., Associate Professor
Wilkins, Bert, Ph.D., Associate Professor

DEPARTMENT OF FOOD SCIENCE

Grodner, Robert M., Ph.D., Professor
Liuzzo, Joseph A., Ph.D., Professor
Meyers, Samuel P., Ph.D., Professor
Novak, Arthur F., Ph.D., Head and Professor
Rao, Ramachandra M.R., Ph.D., Assistant Professor

SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT

Avault, James W., Ph.D., Associate Professor of Fisheries
Bryan, Charles F., Leader of Fisheries

Culley, Dudley D., Ph.D., Assistant Professor of Fisheries
Hamilton, Robert B., Ph.D., Assistant Professor of Forestry
Truesdale, Frank M., Ph.D., Assistant Professor of Fisheries

DEPARTMENT OF GEOGRAPHY AND ANTHROPOLOGY

McIntire, William G., Ph.D., Professor of Geography and Marine Sciences
Muller, Robert A., Ph.D., Associate Professor of Geography
Walker, H.J., Ph.D., Chairman and Professor of Geography and Anthropology
West, Robert, Ph.D., Boyd Professor of Geography and Anthropology

DEPARTMENT OF GEOLOGY

Ferrell, Ray E., Ph.D., Assistant Professor
Hanor, Jeffrey S., Ph.D., Assistant Professor
Moore, Clyde H., Ph.D., Associate Professor
Morgan, James P., Ph.D., Chairman and Professor
Perkins, Robert F., Ph.D., Professor

SCHOOL OF LAW

Hershman, Marc J., J.D., Campanile Charities Professor of Marine Resources Law
Knight, H. Gary, J.D., Associate Professor of Marine Sciences and Law

DEPARTMENT OF MICROBIOLOGY

Colmer, Arthur R., Ph.D., Alumni Professor

DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY

Bennett, Harry J., Ph.D., Professor of Zoology
Fitzsimons, J. Michael, Ph.D., Assistant Professor of Zoology and Physiology
Harmon, Walter J., Ph.D., Chairman and Professor of Zoology and Physiology
Meier, Albert H., Ph.D., Professor of Zoology and Physiology
Stickle, William B., Assistant Professor of Zoology

To obtain further information, address all inquiries directly to:

Dr. Jack R. Van Lopik, Chairman
Department of Marine Sciences
Louisiana State University
Baton Rouge, Louisiana 70803

In the spring of 1970, the Louisiana State University Law School began use of its new law center which contains extensive classroom and research facilities. Particular emphasis has been given, with assistance from the Office of Sea Grant Programs, to the acquisition of a comprehensive library in the field of marine resources law. Individual enclosed research carrels are available for use by graduate law students and the staff and facilities of the university's Center for Wetland Resources are available for interdisciplinary research and consultation.

An LL.M. (Master of Laws) program with specialization in marine resources law and policy has been authorized, but has not yet been implemented. This degree program will require degree candidates to possess the LL.B. or J.D. degree and will divide required courses (minimum of 24 semester hours) between the law school and the Department of Marine Sciences.

The following courses are offered singly and in conjunction with the above program:

157	International Law	3
164	Marine Resources Law I	3
165	Marine Resources Law II	3
167	Seminar in Coastal Zone Management	2

The instructional staff for the courses listed above includes the following:

Hershman, Marc J., J.D., Research Director, Coastal Resources Law, Sea Grant Legal Program
Knight, H. Gary, J.D., Campanile Charities Professor of Marine Resources Law

To obtain further information, address all inquiries directly to:

Prof. H. Gary Knight
L.S.U. Law Center
Baton Rouge, Louisiana 70803

The School of Forestry and Wildlife Management has three laboratories on the campus available for marine and marine-related research in the field of fisheries. The school also has access to various facilities of the Louisiana Wild Life and Fisheries Commission. Most notable is the marine lab at Grand Terre, La., and the Rockefeller Wildlife Refuge at Grand Chenier, La. At Grand Terre, the facility has been used to study the effects of oil pollution on shrimp. At Rockefeller, cooperative research on mariculture is being conducted in some 60 ponds.

The school offers a Master of Science with a major in fisheries. Fishery courses required for the M.S. include: Fundamentals of Fish Culture, Ichthyology, Limnology, and Fishery Research Techniques. Courses may be substituted for required courses, depending on the student's needs and research. Requirements for the M.S. include 30 semester hours of graduate work, including six semester hours of thesis research. There are no language requirements and a minor is optional.

The following courses are offered in conjunction with the above programs:

123	Taxonomy and Ecology of Aquatic Plants	2
125	Limnology	3
126	Fundamentals of Fish Culture	3
145	Ichthyology	3
230	Fish Parasites and Diseases	2
232	Fishery Research Techniques	2
236	Water Pollution Biology	3
238	Fisheries Hydrography	3
239	Shellfisheries Biology	3
240	Mariculture	3

The instructional staff for the courses listed above includes the following university and unit personnel:

Avault, James W. Jr., Ph.D., Associate Professor of Fisheries
de la Bretonne, Laurence W., Jr., M.S., Instructor of Fisheries
Culley, Dudley D., Jr., Ph.D., Assistant Professor of Fisheries
Truesdale, Frank M., Ph.D., Assistant Professor of Fisheries
Bryan, Charles F., Ph.D., Unit Leader, Cooperative Fisheries Unit
Herke, William H., M.S., Assistant Unit Leader, Cooperative Fisheries Unit

To obtain further information, address all inquiries directly to:

Leslie L. Glasgow, Assistant Director
School of Forestry and Wildlife Management
Louisiana State University
Baton Rouge, Louisiana 70803

McGILL UNIVERSITY
Montreal, Quebec, Canada

The Marine Sciences Centre of McGill University is situated at 772 Sherbrooke Street West in Montreal, opposite the main university campus.

Research at the Marine Sciences Centre is carried out in a broad diversity of marine environments, including the Arctic regions, the Gulf of St. Lawrence, the estuary of the St. Lawrence River and the Caribbean Sea. Participation in oceanographic cruises organized by the Bedford Institute at Dartmouth, Nova Scotia, or other government agencies, can be arranged. The Bellairs Research Institute of McGill University in Barbados, West Indies, which opened in 1954, is a research centre specializing in tropical marine ecology. It owns a 50-foot vessel and has potential for work in other aspects of the marine sciences.

Biological collections are available at the Redpath Museum of McGill University, with special laboratory facilities for the study of marine invertebrates. An up-to-date collection of publications in oceanography and related matters, as well as many journals in the marine fields, is kept in the library of the Marine Sciences Centre.

Masters and doctoral degrees are offered in the following subjects: marine biology, physical oceanography and marine geology. Graduate students are expected to take certain basic courses, including those considered necessary for their training and for the development of their particular fields of specialization. Primary emphasis for both the M.Sc. and Ph.D. degrees is placed upon research and thesis presentation. Ph.D. candidates are required to pass a comprehensive examination in their second year of study; this examination covers the whole field of marine science but allows for the specialized interests and training of each student. Ph.D. candidates are also required to defend their theses at an oral examination.

Four Ph.D. degrees and five M.Sc. degrees were granted in the academic year of 1971-72.

The following courses are offered in the Marine Sciences Centre:

UNDERGRADUATE

BIOLOGICAL SCIENCES

177-440A	Marine Environment	3
177-441B	Biological Oceanography	3

PHYSICAL SCIENCES

198-309A	Descriptive Oceanography	3
198-319B	Introduction to Dynamical Oceanography	3

GRADUATE

BIOLOGICAL SCIENCES

395-636-D	Advanced Zoology of the Mollusca and Crustacea	6
395-639A	Tropical Marine Ecology	3
395-691D	Advanced Marine Ecology	6

PHYSICAL SCIENCES

395-695A	Physics of the Ocean	3
395-696B	Seminar course in Physical Oceanography	3

GEOLOGICAL SCIENCES

395-697B	Marine Geology and Geochemistry	3
395-721B	Recent Sediments and Marine Geology	6

GENERAL

395-660D	Seminar in General Oceanography	
395-698B	Topics in Oceanography	3

The full time staff of the Marine Sciences Centre is as follows:

BIOLOGY

Dunbar, M.J., Ph.D., Professor
Lalli, C.M., Ph.D., Associate Professor
Lewis, J.B., Ph.D., Professor (Director, Redpath Museum)
MacLellan, D.C., M.Sc., Lecturer
Sander, F., Ph.D., Assistant Professor (Director, Bellairs Research Institute)
Steven, D.M., Ph.D., Professor

PHYSICS

Ingram, R.G., Ph.D., Assistant Professor
Langleben, M.P., Ph.D., Professor
Pounder, E.R., Ph.D., Professor (Vice-Chairman)

GEOLOGICAL SCIENCES

d'Anglejan, B.F., Ph.D., Associate Professor (Chairman)

For further information, please address enquiries directly to:

Professor B.F. d'Anglejan, Chairman
Marine Sciences Centre
McGill University
P.O. Box 6070
Montreal 101, PQ, Canada

UNIVERSITY OF MAINE
Orono, Maine 04473

The university offers marine science courses both at the Orono campus and at the marine research station, the Ira C. Darling Center for Research, Teaching and Service, at Walpole. Facilities at Orono include classrooms and laboratories in the Departments of Bacteriology, Botany and Plant Pathology, Geological Sciences, and Zoology, and IBM 360-30 and IBM 1800 computers. At Walpole, 100 miles south of Orono, facilities on a 136-acre site include a classroom, research laboratories, access terminal for the Orono computing equipment, library, year-round accommodations for students, two 34-foot research vessels, small craft and waterfront facilities. Open ocean research capability is provided by cooperative use of vessels at other institutions.

The following degrees are offered by the Department of Oceanography:

Ph.D. in Oceanography. Required courses are OC 201, 220, 241, 260 and 391. All students must also obtain research experience at sea, pass written and oral comprehensive examinations, demonstrate reading knowledge of two foreign languages, and complete and defend a research dissertation.

M.S. in Oceanography.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF MICROBIOLOGY

Mb 201	Marine Microbiology	3

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

Bt 163	Introduction to Phycology	4

DEPARTMENT OF GEOLOGICAL SCIENCES

Gy 218	Low Temperature-Pressure Geochemistry	3
Gy 221	Sedimentology	3
Gy 226	Micropaleontology	4
Gy 241	Glacial Geology	3
Gy 242	Quartenary Environments and Climatic Change	3
Gy 260	Marine Geology	3
Gy 264	Structure and Tectonics of the Seafloor	3

DEPARTMENT OF OCEANOGRAPHY

Oc 150	Oceanography Today	3
Oc 170	Introduction to Oceanography	3
Oc 201	Biological Oceanography	3
Oc 208	Anatomy and Classification of Fishes	5
Oc 210	Marine Invertebrate Zoology	5
Oc 226	Chemical Oceanography	3
Oc 241	Physical Oceanography	3
Oc 260	Marine Geology	3
Oc 264	Structure and Tectonics of the Seafloor	3
Oc 266	Micropaleontology	4
Oc 267	Actuopaleontology	2
Oc 302	Marine Plankton	3
Oc 393	Problems in Biological Oceanography	arr.
Oc 391	Oceanography Seminar	1
Oc 399	Graduate Thesis	--

DEPARTMENT OF ZOOLOGY

Zo 168	Limnology	4
IDL 170	Introduction to Oceanography	3
Zo 171	Fishery Biology	4
IDL 201	Biological Oceanography	3
IDL 208	Anatomy and Classification of Fishes	5
IDL 210	Marine Invertebrate Zoology	5
Zo 232	Ichthyology	4
Zo 292	Functional Anatomy of Marine Invertebrates	3
Zo 357	Population Dynamics	2
Zo 362	Estuarine Ecology	4

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

Vadas, Robert L., Ph.D., Assistant Professor of Botany, Oceanography and Zoology

DEPARTMENT OF GEOLOGICAL SCIENCES

Borns, Harold W., Jr., Professor
Denton, George H., Ph.D., Associate Professor
Hall, Bradford A., Ph.D., Associate Professor
Norton, Stephen A., Ph.D., Assistant Professor
Osberg, Philip H., Ph.D., Professor and Head of the Department

DEPARTMENT OF MICROBIOLOGY

Pratt, Darrell B., Ph.D., Professor and Chairman of the Department and Professor of Zoology

DEPARTMENT OF OCEANOGRAPHY

Dean, David, Ph.D., Professor and Acting Head of the Department and Professor of Zoology
DeWitt, Hugh H., Ph.D., Assistant Professor of Oceanography and Zoology
Fink, L. Kenneth, Jr., Ph.D., Assistant Professor of Oceanography and Geological Sciences
Green, Edward J., Ph.D., Associate Professor of Oceanography and Geological Sciences
Hidu, Herbert, Ph.D., Assistant Professor of Oceanography and Zoology
Mazurkiewicz, Michael, Ph.D., Assistant Professor Oceanography and Biology, UMP-G
McAlice, Bernard J., Ph.D., Assistant Professor of Oceanography and Zoology
Schnitker, Detmar F., Ph.D., Assistant Professor of Oceanography and Geological Sciences

DEPARTMENT OF PLANT AND SOIL SCIENCES

Lotse, Erik G., Agronomie Licentiat Associate Professor of Soil Chemistry

DEPARTMENT OF ZOOLOGY

Dearborn, John H., Ph.D., Associate Professor of Zoology and Oceanography
Gregory, Richard W., Ph.D., Assistant Professor of Zoology
Hatch, Richard W., Ph.D., Assistant Professor of Zoology
McCleave, James D., Ph.D., Assistant Professor of Zoology

To obtain further information, address all inquiries directly to:

The Dean of the Graduate School
University of Maine
Orono, Maine 04473

MAINE MARITIME ACADEMY
Castine, Maine

The academy offers marine science courses utilizing the 10,000-ton steam training vessel State of Maine, the 75-foot training vessel Pathfinder, and a number of yachts ranging in size from 27 feet to 60 feet as well as several motor launches and work boats. The training vessels are equipped with all the normal electronic gear, such as radar, loran, fathometers, etc. Castine is a deep-water harbor, accommodating deep-draft ships, and the academy's wharves are adequate. The dock-side facilities include a machine shop, forge and foundry, a steam laboratory equipped with an atomic reactor and associated equipment for the nuclear propulsion training program. This building also contains a classroom equipped for electronic navigation training, engineering classrooms, a marlinespike seamanship laboratory, and a steam and electric power laboratory. A towing tank and a scale model tanker in a tank with a full size cargo control room simulator are available.

The following degrees are offered:

B.S. in Marine Science (Department of Nautical Science). The curriculum offered by this department gives the professional courses which are required to qualify the deck student to receive a degree and, after passing the required U.S. Coast Guard examination, a federal license in the merchant marine. This curriculum is designed to familiarize the deck student with all phases of navigation and piloting, rules and regulations, deck seamanship, cargo handling and stowage, visual signaling, ship handling and management.

B.S. in Marine Engineering (Department of Marine Engineering). The engineering department offers courses which pertain directly to design, operation and maintenance of marine power plants. These courses are re-

quired to qualify the engineering student to receive a degree and, after passing the required U. S. Coast Guard examination, a federal license in the merchant marine. The department not only offers a thorough training in the fundamentals of engineering, but also coordinates theory and practice by relating classroom studies to the student's practical experience aboard ship and in the on-campus functional training engineering laboratory.

The Department of Arts and Sciences offers both core and elective courses in order to enrich the professional deck or engineering student's background. All students are required to present 15 semester credit hours of elective courses.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF NAUTICAL SCIENCE

Ns	1	Deck Indoctrination	3
Ns	2	Ship Structure	3
Ns	3	Deck Drawing	1.5
Ns	4	Stability	2
Ns	5	Meteorology I	3
Ns	6	Meteorology II	1
Ns	7	Cargo I	3
Ns	8	Cargo II	3
Ns	9	Deck Mathematics	1
Ns	10	Seamanship I	2
Ns	11	Seamanship II	3
Ns	12	Seamanship III	3
Ns	13	Seamanship IV	1
Ns	14	Rules and Regulations I	3
Ns	15	Rules and Regulations II	1
Ns	16	Rules of the Road I	2
Ns	17	Rules of the Road II	2
Ns	18	Pilot Rules	2
Ns	19	Rules of Nautical Road	2
Ns	20	Communications I	1
Ns	21	Communications II	1
Ns	22	Marlinespike	1.5
Ns	23	Lifeboat	1
Ns	30	Plane Sailing Navigation	3
Ns	31	Celestial Navigation I	3
Ns	32	Celestial Navigation II	3
Ns	33	Celestial Navigation III	2
Ns	34	Electronic Navigation I	2
Ns	35	Electronic Navigation II	2
Ns	36	General Navigation I	3
Ns	40	Ship Business and Industrial Relations	2

DEPARTMENT OF MARINE ENGINEERING

Eg	1	Engineering Fundamentals	2.5
Eg	2	Electricity	3
Eg	3	Engineering Graphics	3
Eg	4	Applied Hydraulics	3
Eg	5	Automation	3
Eg	6	Engineering Mathematics	2
Eg	7	Steam Engines	1.5
Eg	8	Engine Safety	1.5
Eg	10	Electrical Engineering I	3
Eg	11	Electrical Engineering II	3
Eg	12	Electrical Engineering III	3
Eg	14	Steam Generators I	3
Eg	15	Steam Generators II	3
Eg	17	Steam Propulsion I	3
Eg	18	Steam Propulsion II	3
Eg	19	Steam Propulsion III	3
Eg	21	Engineering Lab I	2
Eg	22	Engineering Lab II	2
Eg	24	Machine Tool Operation I	2.5
Eg	25	Machine Tool Operation II	2
Eg	26	Machine Tool Operation II	2
Eg	28	Nuclear Engineering I	2.5
Eg	29	Nuclear Engineering II	2.5
Eg	31	Diesel Engineering I	3
Eg	32	Diesel Engineering II	1.5
Eg	34	Refrigeration	2
Eg	35	Refrigeration and Air Conditioning	1.5
Eg	40	Ship Business and Industrial Relations	2

DEPARTMENT OF GENERAL EDUCATION

As	10	Introductory Astronomy	3
Ec	10	Marine Shipping Economics	3
Lw	1	Admiralty Law	3
Na	10	Statics for Ship Design	3
Na	30	Strength of Materials for Ship Construction	3
Na	31	Fluid Mechanics and Dynamics of Ships	3
Na	32	Applied Naval Architecture	3
Na	33	Ship Construction and Inspection	3
Oc	1	Introduction to Oceanography	3
Oc	10	Geological Oceanography	3
Oc	11	Physical and Chemical Oceanography	3
Oc	12	Biological Oceanography	3
Oc	30	Ecology and Pollution	3
Oc	31	Ocean Research	3
Tr	10	Marine Transportation	3
Tr	11	Marine Insurance	3
Tr	12	Ocean Traffic and Export-Import Practice	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF NAUTICAL SCIENCE

Campbell, Thomas, B.S., Assistant Professor
Geissler, Edward J., B.S., Assistant Professor
Hathaway, Louis S., B.S., Assistant Professor
Nichols, Joseph F., Assistant Professor of Stability and Ship's Structure
Sawyer, Sherman G., Assistant Professor in Navigation, Chairman of Department
Terry, Russell H., Professor of Navigation

DEPARTMENT OF ENGINEERING

Brown, Edward F., Associate Professor
Creighton, Franklyn W., Lecturer
Goodwin, Francis X., B.S., Assistant Professor
Jacobs, George P., Assistant Professor
Marks, Roger A., Assistant Professor and Chairman
Robinson, Charles S.L., S.M., Associate Professor
Robinson, P.G., B.S., Assistant Professor
Snow, John F., Assistant Professor
Wiles, James F., Associate Professor

DEPARTMENT OF ARTS AND SCIENCES

Barlow, John, Ph.D., Associate Professor of Oceanography
Kennaday, John M., Ed.M., Visiting Professor of Astronomy
Poor, P. Thurston, B.A., Associate Professor in English
Wyman, David B., M.S., Assistant Professor in Oceanography and Naval Architecture

To obtain further information, address all inquiries directly to:

Capt. Edward E. Conrad, Academic Dean
Maine Maritime Academy
Castine, Maine 04421

THE MARINE SCIENCE CONSORTIUM, INC.
Administrative Office
P. O. Box 43, Millersville, Pa. 17551

PARTICIPATING INSTITUTIONS:

The American University, Washington, D.C. 20016.

Bloomsburg State College, Bloomsburg, Pa. 16912
California State College, California, Pa. 15419
The Catholic University of America, Washington, D.C. 20017
Cheyney State College, Cheyney, Pa. 19319
East Stroudsburg State College, East Stroudsburg, Pa. 18301
Edinboro State College, Edinboro, Pa. 16412
Federal City College, Washington, D.C. 20001
Indiana University of Pennsylvania, Indiana, Pa. 15701
Kutztown State College, Kutztown, Pa. 19530
Millersville State College, Millersville, Pa. 17551
The Pennsylvania State University, University Park, Pa. 16802
Shippensburg State College, Shippensburg, Pa. 17257
Slippery Rock State College, Slippery Rock, Pa. 16057
University of Maryland, Princess Anne, Md. 21853
Washington Technical Institute, Washington, D.C. 20008
West Chester State College, West Chester, Pa. 19380
West Virginia University, Morgantown, W. Va. 26506

Each of the participating institutions offers courses in oceanography, for which classroom facilities, laboratory space, library and computer support are available on the various campuses.

The consortium is a member of the Institute for the Development of Riverine and Estuarine Systems (IDRES) and the University National Oceanographic Laboratories System (UNOLS) and has cooperative arrangements with NASA, Wallops Island, Va., and the National Marine Fisheries Service, Oxford, Md.

In addition, the consortium operates two Marine Science Centers, one in Lewes, Del., with facilities for up to 60 students and faculty, the other in Wallops Island, Va., where more than 100 participants can be accommodated. The centers consist of lecture rooms, wet and dry laboratories, boathouses, workshops and garages, dormitories and cafeteria services, as well as docking facilities.

Vessels owned and operated by the consortium include: the R/V Annandale, a 90-foot, ocean-going research ship with a permanent crew of five and up to 12 bunk spaces for additional scientific crew, equipped with radar, loran A & C, depth recorders, side-scanning sonar, weather facsimile recorder, SSB and VHF radios, winches, dry and wet labs; the R/V Delaware Bay, a 50-foot, low-magnetic ex-mine diving tender equipped with radar, loran, CBR and VHF radios, several winches, and diving lockers; the Chincoteague Bay, a 40-foot flat-bottom monitor for use in shallow waters; the R/V Cat, a 34-foot research catamaran with center well, traveling overhead gantry, hydrowinch, radar, loran-C, depth recorder and VHF radio; and five small boats used for nearshore work.

Degrees are granted only through the participating institutions and include B.A. and B.S. in biology, geology, geography, earth sciences, and M.A., M.S., M.Ed., and Ph.D. degrees.

The following three-credit courses are offered during five summer sessions of three weeks each, at the two marine centers. Students apply for admission and pay board, lodging and operations fee to the consortium, after which they register and pay tuition to one of the participating institutions. Credits may also be transferred to other colleges and universities.

UNDERGRADUATE

MS 110	Introduction to Oceanography
MS 211	Field Methods in Oceanography
MS 221	Marine Invertebrates
MS 241	Marine Biology
MS 250	Management of Wetland Wildlife
MS 260	Marine Ecology
MS 270	Scuba Diving
MS 280	Field Biology
MS 331	Chemical Oceanography
MS 342	Marine Botany
MS 343	Marine Ichthyology
MS 344	Anatomy of Marine Chordates
MS 362	Marine Geology
MS 364	Physical Oceanography
MS 370	Marine Meteorology
MS 420	Marine Micropaleontology
MS 431	Ecology of Marine Plankton
MS 457	Marine Geophysics
MS 458	Exploration Methods in Marine Geology
MS 459	Coastal Geomorphology
MS 498	Topics in Marine Science

GRADUATE

MS 500	Problems in Marine Science
MS 510	Oceanography I
MS 511	Oceanography II
MS 520	Marine Microbiology
MS 530	Coastal Sedimentation
MS 540	Environmental Science Education
MS 555	Ocean Resources
MS 560	Ocean Engineering
MS 570	Research Cruise
MS 598	Topics in Marine Science
MS 600	Master's Thesis (variable number of credits)
MS 700	Ph.D. Dissertation (variable number of credits)

For information on three-day pre-college oceanography programs, summer institutes and workshops, research cruises, etc., please contact the Marine Science Consortium.

Faculty members teaching at the consortium:

MARINE BIOLOGY

Anderson, R., Ph.D., Associate Professor, The American University
Archibald, Patricia, Ph.D., Associate Professor, Slippery Rock State College
Banta, W.C., Ph.D., Assistant Professor, The American University
Bursey, C.R., Ph.D., Assistant Professor, Penn State College
Champ, M.A., Ph.D., Assistant Professor, The American University
Dietrich, W., Ph.D., Assistant Professor, Indiana University of Pennsylvania
Griffin, W.R., Ph.D., Assistant Professor, The American University
Ha, S., Ph.D., Assistant Professor, Millersville State College
Haase, B.L., Ph.D., Associate Professor, East Stroudsburg State College
Hays, H.E., M.S., Assistant Professor, Shippensburg State College
Henderson, A., D.Ed., Professor, Millersville State College
Hillson, C.J., Ph.D., Professor, Penn State University
Humphreys, J.G., Ph.D., Associate Professor, Indiana University of Pennsylvania
Jones, H.G., M.S., Assistant Professor, West Chester State College
Marshall, J.A., Ph.D., Assistant Professor, West Virginia University
Miller, K.G., M.S., Associate Professor, Millersville State College
Phelps, Harriette, Ph.D., Associate Professor, Federal City College
Radinovsky, S., Ph.D., Professor, Millersville State College
Rebach, S., Ph.D., Assistant Professor, University of Maryland
Romig, R.F., Ph.D., Associate Professor, West Chester State College
Sagar, R., M.S., Associate Professor, Bloomsburg State College

Schrock, G.F., Ph.D., Professor, Indiana University of Pennsylvania
Smith, R.L., Ph.D., Professor, West Virginia University
Stickle, W., Ph.D., Instructor, Marine Science Consortium
Taylor, Rhoda E., Ph.D., Associate Professor, Slippery Rock State College
Vaughn, J.P., D.Ed., Associate Professor, Bloomsburg State College

MARINE GEOLOGY

Behling, R., Ph.D., Assistant Professor, West Virginia University
Bushnell, K., Ph.D., Associate Professor, Slippery Rock State College
Donaldson, A.C., Ph.D., Professor, West Virginia University
Ehleiter, J.E., M.A., Associate Professor, West Chester State College
Guber, A.L., Ph.D., Associate Professor, Penn State College
McClure, L., M.S., Associate Professor, Bloomsburg State College
Oostdam, B.L., Ph.D., Professor, Millersville State College
Schmalz, R.F., Ph.D., Professor, Penn State University
Stratton, J.F., Ph.D., Instructor, Marine Science Consortium
Swift, R.N., M.S., Instructor, Marine Science Consortium
Ward, A.N., Ph.D., Associate Professor, Slippery Rock State College
Weber, J.N., Ph.D., Associate Professor, Penn State University
Wegweiser, A.E., Ph.D., Professor, Edinboro State College
Williams, E.G., Ph.D., Professor, Penn State University

PHYSICAL OCEANOGRAPHY

Berryman, Matilene, B.S., Professor, Washington Technical Institute
Davis, D.R., Ph.D., Associate Professor, Millersville State College
Gilheany, J.J., Ph.D., Associate Professor, The Catholic University of America
Meideros, R.W., Ph.D., Professor, West Chester State College
Mobley, Mary, M.C., M.S., Associate Professor, Kutztown State College
Prince, P.A., M.S., Associate Professor, Indiana University of Pennsylvania
Robinson, L., B.S., Instructor, Marine Science Consortium
Sayre, W.G., Ph.D., Assistant Professor, Slippery Rock State College
Szucs, F.K., Ph.D., Professor, Slippery Rock State College
Thiruvengadam, A., Ph.D., Associate Professor, The Catholic University of America
Torosian, Anna, M.S., Associate Professor, Federal City College
Whitmarsh, D.C., M.S., Associate Professor, Penn State University

ENVIRONMENTAL SCIENCE EDUCATION

Baumann, M. Christine, B.S., Instructor, Marine Science Consortium
Black, W.L., Ph.D., Professor, California State College
Chinnis, R.J., Ed.D., Associate Professor, The American University
Ewald, J., B.S., Instructor, Marine Science Consortium
Patrick, T.M., B.S., Instructor, Marine Science Consortium
Sager, Martha C., Ph.D., Professor, The American University
Stenger, J., M.S., Instructor, Marine Science Consortium

For applications and additional information, please directly contact:

Dr. B. L. Oostdam, President
The Marine Science Consortium, Inc.
P.O. Box 43
Millersville, Pennsylvania 17551
(717) 872-5411

UNIVERSITY OF MARYLAND
College Park, Maryland 20742

Marine facilities exist in the Chesapeake Biological Laboratories and at Horn's Point for work in Chesapeake Bay. Tropical marine botany is carried out on the reefs of the Caribbean in cooperation with the Department of Marine Sciences of Puerto Rico. Students are urged to expand their training by summer study at the Marine Biological Laboratory at Woods Hole, Massachusetts.

The Department of Botany offers broad training and intensive specialization in genetics, molecular biology, physiology, biochemistry, biophysics, ecology, taxonomy, anatomy -- morphology, mycology, pathology, virology, nematology, phycology and marine biology.

The Master of Science and Doctor of Philosophy degrees require a solid background in mathematics, chemistry, physics and the other biological sciences. However, each student's program is designed for specialization within the field and there is considerable flexibility with regard to specific course prescription. The Graduate Record Examination is not required. The selection process relies primarily on the student's previous academic record and communications from professors in his previous curriculum.

The following degrees are offered:

1. M.S. in Botany (specialty in marine botany). The Master of Science degree in awarded for successful completion of a minimum of 30 hours of advanced study beyond the undergraduate level. The student must declare a major subject field and a minor subject field. Twelve to 15 credit hours will be in the major area and nine to 12 hours, depending upon the number in the major area, will be in the minor field. Supportive courses are selected from the other departments for those whose interest is marine biology. A thesis is required.

2. Ph.D. in Botany (specialty in marine botany). The candidate must select an area of major emphasis and one or two areas of minor emphasis. Each candidate must take certain background tests and must successfully pass the following academic examinations: a six-hour preliminary examination taken relatively early in the program; a final written comprehensive examination covering the entire graduate course of study; and a final oral or written examination directed primarily toward the research project. A thesis is required.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BOTANY

411	Plant Anatomy	3
413	Plant Geography	2
426	Mycology	4
462	Plant Ecology	2

465	Systematic Botany	3
475	Algal Systematics	3
477	Marine Plant Botany	4
497	Special Problems in Marine Research	1-3
615	Plant Cytogenetics	3
616	Nucleic Acids and Molecular Genetics	2
621	Physiology of Fungi	2
625	Physiology of Pathogens and Host-Pathogen Relationships	3
632	Plant Virology	2
641	Advanced Plant Physiology	2
642	Plant Biochemistry	2
652	Plant Biophysics	2
661	Advanced Plant Ecology	3
672	Physiology of Algae	2
674	Physiology of Algae Laboratory	1
699	Special Problems in Botany	1-3

Undergraduate students may take 400 level courses.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BOTANY

Brown, Russell G. Professor
Corbett, M. Kenneth, Professor
Curtis, Charles R., Associate Professor
Galloway, Raymond A., Professor
Karlander, Edward P., Associate Professor
Klarman, William L., Associate Professor
Krusberg, Lorin R., Professor
Morgan, Delbert T., Jr., Professor
Motta, Jerome J., Assistant Professor
Patterson, Glenn W., Associate Professor
Rappleye, Robert D., Associate Professor
Reveal, James L., Assistant Professor
Sorokin, Constantine, Research Professor
Stevenson, John C., Assistant Professor
Van Valkenburg, Shirley D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Hugh D. Sisler, Acting Chairman
Department of Botany
University of Maryland
College Park, Maryland 20742

The Mechanical Engineering Laboratories contain apparatus and instrumentation for conducting research in fluid dynamics and transfer processes on marine-related problems. A flume, tanks, pumps and auxiliary equipment have been used in recent projects on deep water heat transfer, jellyfish barriers, vortex-induced vibration and heat dissipation from power plant effluent. Wind tunnel and air flow facilities are also available. The Chesapeake Biological Laboratory at Solomons, Maryland, (a field research facility) is part of the University of Maryland and cooperates with departments on problems of mutual interest. Government and private laboratories in the Annapolis, Baltimore, Washington area have provided support and facilities to assist in research of mutual interests.

The following degrees are offered:

1. Ph.D. in Mechanical Engineering. The Ph.D. in Mechanical Engineering emphasizing ocean engineering or marine sciences is administered by the fluid mechanics group of the M.E. Department. Although specific programs are tailored to fit individual needs and backgrounds, the suggested general program consists of 48 semester hours of courses which are distributed as follows: 27 semester hours in fluid mechanics (which may include courses in aerodynamics, meteorology and ocean engineering), nine hours in mathematics and 12 hours in two other areas (either within the four other M.E. groups or outside the department).

All incoming students must take a qualifying examination to determine what remedial work they need and to determine their fitness for a Ph.D. program. At the end of their program of course work, they must pass a written comprehensive examination before continuing on to write a dissertation. No foreign language is required.

2. M.S. in Mechanical Engineering. The M.S. emphasizing ocean engineering or marine sciences is also administered by the fluid mechanics group of the Mechanical Engineering Department. A thesis or non-thesis option is available. The course of study includes 12 hours in fluid mechanics (or appropriate equivalent), six hours of mathematics, six hours in another area of mechanical engineering (or outside of the department), plus either six hours of thesis or six hours of additional courses in the general area of fluid mechanics for a total of 30 semester hours.

The following courses are offered in conjunction with the above programs:

GRADUATE

AGRICULTURAL ENGINEERING DEPARTMENT

AGEN 435	Aquacultural Engineering	3

DEPARTMENT OF CHEMISTRY

CHEM 475	Chemical Oceanography	3

METEOROLOGY

METO 420	Physical and Dynamical Oceanography	3
METO 422	Ocean Waves, Tides and Turbulence	3

DEPARTMENT OF MECHANICAL ENGINEERING

ENME 450	Mechanical Engineering Analysis for the Oceanic Environment	3
ENME 451	Mechanical Engineering Systems for Underwater Operations	3
ENME 452*	Physical and Dynamical Oceanography	3
ENME 453*	Ocean Waves, Tides and Turbulence	3

Courses numbered 4XX are available for either graduate or undergraduate credit.

*ENME 452 and METO 420 are the same course, as are ENME 453 and METO 422. They are taught by members of the meteorology department and by members of the mechanical engineering department.

The instructional staff for the courses listed above consists of the following:

AGRICULTURAL ENGINEERING DEPARTMENT

Wheaton, Frederick W., Ph.D., Research Associate

DEPARTMENT OF CHEMISTRY

Sommer, Sheldon E., Ph.D., Assistant Professor

METEOROLOGY

Faller, Allan J., Ph.D., Research Professor and Instructor of fluid dynamics and applied mathematics

DEPARTMENT OF MECHANICAL ENGINEERING

Marks, Colin H., Ph.D., Associate Professor
Sayre, Clifford L., Jr., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Dr. James W. Dally, Chairman
Department of Mechanical Engineering
College of Engineering
University of Maryland
College Park, Maryland 20742

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Cambridge, Massachusetts 02139

Over the past decade the Massachusetts Institute of Technology has developed a wide range of facilities for applied research related to the utilization of the oceans and the ocean resources. In addition to the facilities in basic and engineering research in the various departments of the institute, the facilities of the Draper Laboratory and the Information Processing Services Center as well as those of the Woods Hole Oceanographic Institution (WHOI) (available to MIT through the joint MIT/WHOI Programs in both ocean engineering and in oceanography), the following special marine-oriented facilities are available at the MIT campus: variable pressure water tunnel, ship model towing tank, acoustics and vibration laboratory, MIT ship structures laboratory, research vessel Shrock, pressure testing facility, a stroboscopic light laboratory and the newly remodeled Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics. This laboratory contains over 30,000 square feet devoted to teaching and research and includes such facilities as a 100-foot wave channel, various channels for sediment studies, a coastal model basin, special flumes for variable density experiments, a special purpose digital computer for experimental control and data reduction, a special purpose analog computer for the analysis of random signals, plus instrumentation for the laboratory and field measurement of turbulence, wave profile and forces, entrained sediments, salinity, heat, dissolved oxygen, B.O.D., etc. Large scale digital computer facilities are available through the Engineering Departments, the Civil Engineering Systems Laboratory, and the M.I.T. Information Processing Center.

The Department of Ocean Engineering concentrates on "engineering for the ocean environment." It emphasizes the scientific background and those engineering sciences necessary to applications in the marine field, as well as engineering fundamentals and their application to a wide spectrum of engineering for modern ocean sciences, ocean exploration, ocean transportation, ship and naval engineering, and the utilization of ocean and coastal zone resources. A flexible curriculum, a departmental faculty with wide and continuing research and industrial experience, and close faculty-student contact all contribute to a sound and effective education.

The following two undergraduate degrees are offered in the Department of Ocean Engineering:

1. B.S. in Ocean Engineering. All undergraduate students are required to take 72 units in the academic area of humanties and social science. In addition, 12 units of chemistry subject matter, 24 units of physics and 24 units of calculus are required. Each student must fulfill the requirement of satisfactorily completing 12 units of credit in a laboratory course. All of the foregoing requirements involve subjects outside the Department of Ocean Engineering. The departmental requirements include the following mandatory subjects: Introduction to Applied Hydrodynamics, Marine Applied Mechanics, A Survey of Ocean Engineering, Applied Ocean Engineering, Differential Equations, and Advanced Calculus for Engineers.

Also 70 units of unrestricted electives plus at least 72 units of planned electives are required. At least one planned elective subject must be selected in four out of these nine areas: acoustics, design, hydrodynamics, instrumentation, materials and fabrication, ocean environment, power and propulsion, probability and structures. Degrees awarded in 1972: one.

2. B.S. in Naval Architecture and Marine Engineering. Requirements are the same as for the B.S. in Ocean Engineering except that out of the 72 units of planned electives at least one subject must be selected in each of the following areas: design, hydrodynamics, materials and fabrication, power and propulsion and structures. Degrees awarded in 1972: three.

The following graduate degrees are offered by the Department of Ocean Engineering:

3. M.S. in Naval Architecture and Marine Engineering Degrees awarded in 1972: 12

4. M.S. in Ocean Engineering. Degrees awarded in 1972: three.

5. M.S. in Shipping and Shipbuilding Management. Degrees awarded in 1972: three.

6. M.S. without specification. Degrees awarded in 1972: four.

Preparation for these graduate degree programs usually includes an undergraduate degree in a field of engineering. Students with a background in physics, mathematics or chemistry may also be accepted with the proviso that they complete background areas in which they are deficient. For students who lack the complete range of background requirements the department is prepared to award the M.S. degree without specification.

7. Ocean Engineer. The objective of a program leading to an engineer degree is a more advanced level and a broader range of competence in engineering and science than that required for the master's degree, but with less emphasis on creative research than that characterizing a doctoral program. In general terms, the master's degree requires a minimum of one academic year and the engineer degree without a concurrent M.S. degree requires two academic years beyond a baccalaureate in the same field.

The requirements for an engineer degree are the satisfactory completion of a program of advanced study and research approved by the department. The minimum program consists of at least 162 subject units and the completion of an acceptable thesis. A department may accept a master's thesis of superior quality for the engineer degree.

A program for an engineer degree ordinarily includes two subjects in the area of economics, industrial management, or political science, and at least 12 units of comprehensive design, such as Design of a Waterborne Vehicle or the equivalent. Degrees awarded in 1972: 25.

8. Doctor of Science. Degrees awarded in 1972: two.

9. Doctor of Philosophy. Degrees awarded in 1972: five.

The basic requirements for a doctorate degree are: completion of a program of advanced study, including a two-part general examination, and completion and oral defense of a thesis on original research.

The program of advanced study and research may be selected in any field approved by the department. The thesis is in this same field. The program often comprises subject areas reaching into several departments. If the field requires substantial participation by two or more departments, an interdepartmental faculty committee may be appointed by the dean of the Graduate School to advise with a graduate registration officer in the administration of the student's program.

Candidates for a doctorate are no longer required to demonstrate a proficience in foreign languages.

The Department of Ocean Engineering also offers a joint program in ocean engineering with the Woods Hole Oceanographic Institution leading to the degrees of Ocean Engineer, Ph.D., or Sc.D. awarded jointly by the two institutions. Students in this program choose to specialize in those areas of ocean engineering related to advancements in marine geophysics, geology, oceanography, or oceanographic instrumentation. Requirements for the joint degrees are similar to those of the corresponding degree awarded by the department above.

The Department of Civil Engineering also offers marine-related graduate degree programs in civil engineering. The focus of these programs is on coastal problems of the marine environment and on constructed marine facilities.

Preparation for these programs of graduate study usually includes an undergraduate degree in civil, mechanical or electrical engineering or oceanography; but, recognizing the possible need for some additional work, students with a background in physics, mathematics, chemistry, and biology may also be accepted. The degrees offered, and their requirements are as follows:

1. M.S. in Civil Engineering. This requires completion of an approved program of at least 66 subject units, of which 42 units must be in "A" subjects, and the completion of an acceptable thesis. Degrees awarded in 1972: 62.

2. M.S. This "unspecified" degree is awarded in cases in which at least 34 units of "A" subjects plus the thesis are not from within the Department of Civil Engineering. This provides one mechanism for pursuing interdepartmental fields of interest. Degrees awarded in 1972: four.

3. Civil Engineer. The "professional" degree, Civil Engineer, is awarded for completion of a program at a more advanced level and over a broader range than that for the master's degree but with less emphasis on creative research than that characterizing a doctoral program. The program content is worked out by the student in consultation with his faculty advisor but must contain at least 162 subject units plus an acceptable thesis. Degrees awarded in 1972: 25.

4. Sc.D. or Ph.D. in Civil Engineering. The basic requirements for the doctorate are: completion of a program of advanced study, including a general examination consisting of a written and an oral portion; and completion and oral defense of a thesis based on original research. Degrees awarded in 1972: 25.

The total doctoral program must include at least 150 units of graduate subject units up to half of which may be specified by the graduate committee in charge of the candidate's major area of specialization. It is for this core material that the candidate is responsible on the general examination. Doctoral candidates are no longer required to demonstrate a proficiency in foreign languages.

The following courses are offered in conjunction with the programs of the Department of Ocean Engineering and the Department of Civil Engineering:

DEPARTMENT OF ENGINEERING

UNDERGRADUATE

1.071	Analysis of Uncertainty	9
1.61J	Structures and Strategics of Ecosystems	12

GRADUATE

1.142	Numerical Methods of Engineering Analysis (A)	9
1.143	Mathematical Optimization Techniques I (A)	9
1.146	Engineering Systems Analysis (A)	9
1.148	Decision Theories and Social Realities in Engineering and Planning (A)	9
1.151	Computer Approaches to Engineering Problems	9
1.154	Simulation Methods (A)	9
1.16J	Special Studies in Systems Engineering (A)	12
1.161J	Modelling and Analysis of Systems Pertaining to National Development (A)	12
1.162	Analytic Formulation of Engineering System Problems (A)	9
1.175	Analysis of Public Systems (A)	9
1.83	Applications of Multivariate Statistical Analysis (A)	9
1.184	Applied Random Processes (A)	9
1.56	Advanced Structural Mechanics (A)	9
1.582	Structural Reliability (A)	9
1.584	Analysis and Design of Shell Structures (A)	9
1.586	Structural Dynamics (A)	9
1.631	Advanced Hydromechanics I (A)	9
1.632	Advanced Hydromechanics II (A)	9
1.681	Experimental Hydromechanics (A)	6
1.69	Waves and Coastal Processes (A)	9
1.70	Mechanics of Sediment Transport (A)	6
1.77	Water Quality Control (A)	8

DEPARTMENT OF OCEAN ENGINEERING

UNDERGRADUATE

13.10	Introduction to Structural Mechanics	10
13.15J	Materials for Ocean Engineers	11
13.25J	Thermodynamics of Power Systems	12
13.30	Ship Structural Analysis and Design	9
13.31	Ship Structural Design	4
13.405	Introductory Ocean Engineering Design	12
13.50	Computer Applications to Marine Problems	8
13.501	Introduction to Computer Applications	9
13.64	Water, Air and Interface Vehicles	8
13.700-13.709	Special Problems in Ocean Engineering	arr
13.73	A Survey of Ocean Engineering	3
13.74	Marine Systems Control	12
13.771-13.773	Industrial Practise in Ocean Engineering	12
13.79	Applied Ocean Engineering	12
13.90	Ocean Engineering Laboratory	12
13.93	Evaluation and Utilization of Marine Resources	12
13.96	Marine Resource Economics	9

GRADUATE

13.02	Marine Hydrodynamics (A)	12
13.021	Hydrodynamics for Ocean Engineers (A)	12
13.03	Advanced Hydromechanics of Ship Design (A)	9
13.04	Two-Dimensional Hydrofoil Theory (A)	12
13.05	Three-Dimensional Hydrofoil Theory (A)	12
13.07	Free Surface Hydrodynamics (A)	9
13.08	Stability and Motion Control of Ocean Vehicles (A)	9
13.09	Potential Flows (A)	9
13.11	Theory of Plates and Shells (A)	9
13.12	Marine Structures (A)	9
13.13	Plastic Analysis of Structures	9
13.16J	Fracture of Structural Materials (A)	9
13.17	Welding Engineering (A)	9
13.21	Ship Power and Propulsion (A)	12
13.22	Naval Ship Propulsion (A)	12
13.26J	Thermal Power Systems (A)	12
13.27	Ocean Engineering Power Systems (A)	6
13.32	Ocean Engineering Structures (A)	9
13.34	Ship Structural Design I(A)	5
13.36	Ocean Engineering Structural Design (A)	5
13.39	Analysis of Techniques for Fabricating Structures (A)	6
13.41	Principles of Ship Design (A)	12
13.42	Design of Ocean Engineering Systems (A)	arr
13.43	Naval Ship-System Design I (A)	9
13.44	Naval Ship-System Design II (A)	arr
13.45T	Principles of Naval Ship Design (A)	6
13.46T	Conceptual Design of Naval Ships (A)	arr
13.47J	Special Studies in Systems Engineering (A)	12
13.61	Netwrok, Scheduling, Routing and Planning (A)	9
13.63	Reliability, Availability and Maintainability of Systems (A)	9
13.65	Ship Production Analysis (A)	9
13.66	Economics of Marine Systems (A)	9
13.67	Marine Decision-Making Under Uncertainty (A)	9
13.68	Management of Marine Systems (A)	9
13.710-13.719	Special Problems in Ocean Engineering	arr
13.72	Random Processes in Ocean Engineering (A)	12
13.80	Mechanical Vibrations and Noise for Ship Designers (A)	9
13.81J	Principles of Acoustics (A)	12
13.82	Acoustics and Shock Response of Marine Structures (A)	9
13.83	Hydroacoustics (A)	9
13.84J	Flow Noise (A)	12
13.85	Fundamentals of Underwater Sound Applications (A)	9
13.86	Sound Transmission in the Ocean (A)	9
13.92J	Public Policy and Use of the Seas (A)	9
13.98	Coastal Zone Management (A)	9
13.990	Oceanographic Systems I	12

13.991	Oceanographic Systems-II	12
13.994	Buoy Engineering	6
13.995	Oceanographic Deep Submergence Engineering	9

DEPARTMENT OF METALLURGY AND MATERIALS SCIENCE

UNDERGRADUATE

3.701J	Materials for Ocean Engineering	11

GRADUATE

3.36J	Welding Engineering (A)	9
3.54	Corrosion (A)	8

DEPARTMENT OF MECHANICAL ENGINEERING

UNDERGRADUATE

2.41J	Thermodynamics of Power Systems	12
2.412	Heat Engineering	12
2.54	Heat Transfer	6

GRADUATE

2.032	Advanced Mechanics (A)	12
2.083	Applied Elasticity (A)	12
2.25	Advanced Fluid Mechanics (A)	12
2.271	Compressible Fluid Mechanics (A)	12
2.275	Turbomachinery Design	12
2.284	Desalination and Water Purification (A)	12
2.451	Intermediate Thermodynamics (A)	12
2.452	Advanced Thermodynamics (A)	12
2.55	Advanced Heat Transfer (A)	12
2.601J	Thermal Power Systems (A)	12
2.621	Gas Turbines (A)	12

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF CIVIL ENGINEERING

Christian, John T., Ph.D., Associate Professor
Connor, Jerome, J., Jr., Sc.D., Professor
Cornell, C. Allin, Ph.D., Associate Professor
de Neufville, Richard L., Ph.D., Associate Professor
Gelhar, Lynn W., Ph.D., Associate Professor
Harleman, Donald, R.F., Sc.D., Professor
Ippen, Arthur T., Ph.D., Institute Professor
Manheim, M.L., Ph.D., Professor
Marks, David H., Ph.D., Associate Professor
Mei, Chiang C., Ph.D., Associate Professor
Perkins, Frank E., Sc.D., Associate Professor
Roessit, J.M.V., Sc.D., Associate Professor
Roos, D., Ph.D., Associate Professor
Sussman, J.M., Ph.D., Associate Professor
Vanmarcke, E.H., Ph.D., Assistant Professor

DEPARTMENT OF OCEAN ENGINEERING

Abkowitz, M.A., Ph.D., Professor of Ocean Engineering
Carmichael, A.D., Ph.D., Professor of Power Engineering
Chryssostomidis, D., Ph.D., Assistant Professor of Naval Architecture
Devanney, J.W., III, Ph.D., Associate Professor of Marine Systems
Dietz, Warren C., Sc.D., Associate Professor of Marine Engineering
Dyer, Ira, Ph.D., Head of Department, Professor of Ocean Engineering
Evans, J.H., B.Eng., Professor of Naval Architecture
Frankel, E.G., Mar.Mech.E., Professor of Marine Systems
Jones, N., Ph.D., Associate Professor of Ocean Engineering
Junger, M.C., Sc.D., Senior Lecturer of Hydroacoustics
Kerwin, J.E., Ph.D., Professor of Naval Architecture
Lassiter, J.B., III, Ph.D., Assistant Professor of Ocean Engineering
Lechey, P., Ph.D., Professor of Applied Mechanics
Mandel, P., B.S., Professor of Naval Architecture
Mansour, A., Ph.D., Associate Professor of Ocean Engineering
Marcus, H.S., D.B.A., Assistant Professor of Marine Systems
Masubuchi, K., D.Eng., Professor of Ocean Engineering
Milgram, J.H., Ph.D., Associate Professor of Naval Architecture
Newman, J.N., Sc.D., Professor of Naval Architecture
Padelford, N.J., Ph.D., Professor of Political Science
Pellini, W.S., B.S., Senior Lecturer of Ocean Engineering Materials
Porter, W.R., Ph.D., Professor of Naval Architecture
Searle, W.F., Jr., Nav.E., Senior Lecturer of Ocean Engineering

DEPARTMENT OF METALLURGY AND MATERIALS

Floe, Carl F., Sc.D., Professor
King, T.B., Ph.D., Professor
Uhlig, H.H., Ph.D., Professor

DEPARTMENT OF ELECTRICAL ENGINEERING

Edgerton, H.E., Sc.D., Professor of Electrical Measurements, Emeritus
Seifert, W.W., Sc.D., Professor of Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Crandell, S.H., Ph.D., Professor of Mechanical Engineering
Hatsopoulos, G.N., Sc.D., Senior Lecturer of Thermodynamics
Haywood, J.B., Ph.D., Associate Professor of Mechanical Engineering
Lardner, T.J., Ph.D., Associate Professor of Mechanical Engineering
Probstein, R.F., Ph.D., Professor of Mechanical Engineering
Rohsenow, W.M., D.Eng., Professor of Mechanical Engineering
Smith, J.L., Sc.D., Professor of Mechanical Engineering
Sonin, A.A., Ph.D., Associate Professor of Mechanical Engineering
Stickney, R.E., Ph.D., Professor of Mechanical Engineering
Wilson, D.G., Ph.D., Associate Professor of Mechanical Engineering

To obtain further information, address inquiries directly to:
Professor Philip Mandel
Department of Ocean Engineering
Room 5-325, M.I.T.
Cambridge, Massachusetts 02139

The graduate program in oceanography is conducted jointly by M.I.T. and the Woods Hole Oceanographic Institution. Three departments in the School of Science at M.I.T. --those of Earth and Planetary Sciences, Meteorology and Biology--are involved in instruction in physical oceanography, marine geology, marine geophysics, marine chemistry and geochemistry, and biological oceanography. Each student has a primary affiliation with one of the three departments.

M. I. T. provides instruction in many fields of science, engineering and the humanities, as well as laboratories, libraries, and computer and data processing services; additionally, a small research boat which is used for local observations and for instrument testing is docked at the M. I. T. facility at Lewis Wharf in Boston. W. H. O. I. brings to the program a large scientific staff involved in many phases of oceanography, along with extensive laboratory facilities on shore and a fleet of seagoing ships devoted to research and instruction. Students may take courses simultaneously at both institutions, and transportation between the two campuses is provided. Thesis research may be undertaken at either institute, the locations of the thesis advisor and the needed facilities usually being the determining factors.

All M. I. T. doctoral candidates in oceanography are considered to be in the joint program and are awarded a joint degree of Ph. D. or Sc. D. in Oceanography. (No distinction is made between the two and a student may choose whichever seems more appropriate to him.) In the first phase of the doctoral program, the student prepares himself for the general examination in the field of his degree; after successfully passing this, he enters the second phase, that of thesis research. The successful defense of a thesis of high quality marks the completion of the program.

The degree of Master of Science is awarded only by M. I. T. Minimum requirements are the completion of an approved program of 66 units, of which at least 42 must be graduate "A" subjects and the presentation of an acceptable thesis.

All applicants to the graduate program should have a strong background in basic mathematics and physics; chemistry is required for students of marine chemistry and biological oceanography while geology is needed for marine geology.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

12.20J	Cycles in the Ocean & Atmosphere	9
12.21	Physical Oceanography	12
19.83	Physical Oceanography I	12

GRADUATE

1.69	Waves and Coastal Processes (A)	9
1.70	Mechanics of Sediment Transport (A)	6
2.283	Fluid Physics of Pollution (A)	12
6.573	Introduction to Random Processes (A)	12
7.23	Microbial Physiology (A)	12
7.25	Topics in Virology (A)	8
7.41	Biological Oceanography (A)	9
7.71	Biophysical Chemistry (A)	6
7.72	Advanced Biochemistry (A)	12
12.71	Introduction to Physical Oceanography	9
12.73	Introduction to Marine Geology and Geophysics (A)	10
12.75	Chemical Oceanography (A)	9
12.83	Marine Geochemistry (A)	12
12.85	Oceanographic Time Series (A)	9
12.81	Waves and Tides (A)	12
18.308	Wave Motion (A)	12
18.356	Rotating Fluids (A)	12
18.358	Hydrodynamic Stability and Turbulence (A)	12
19.22	Air and Sea Instruments (A)	11
19.24	Fluid Dynamics Laboratory (A)	10
19.61	Introduction to Dynamical Meteorology (A)	12
19.65	Turbulence and Random Phenomena in Fluid Mechanics (A)	9
19.67	Planetary Fluid Dynamics (A)	12
19.80	Surface and Internal Waves (A)	9
19.81	Introduction to Oceanic Models (A)	9
19.82	Introduction to Oceanic Models (A)	9
19.84	Dynamic Oceanography (A)	9
19.86	Ocean Circulations (A)	9
19.88	Oceanic Variability (A)	9

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Edmond, John M., Ph. D., Assistant Professor of Oceanography
Frey, Frederick A., Ph. D., Associate Professor of Geochemistry
Press, Frank, Ph. D., Head of Department and Professor of Geophysics
Sclater, John G., Ph. D., Associate Professor of Oceanography
Simmons, M. Gene, Ph. D., Professor of Geophysics
Southard, John B., Ph. D., Assistant Professor of Geology
Wunsch, Carl I., Ph. D., Associate Professor of Oceanography

DEPARTMENT OF METEOROLOGY

Beardsley, Robert C., Ph. D., Associate Professor of Oceanography
Charney, Jule G., Ph. D., Professor of Meteorology
Houghton, Henry G., S. M., Professor of Meteorology
Keily, Delbar P., S. B., Associate Professor of Meteorology
Mollo-Christensen, Erik L., Sc. D., Professor of Meteorology
Phillips, Norman A., Ph. D., Head of Department and Professor of Meteorology
Stommel, Henry M., B. S., Professor of Oceanography

DEPARTMENT OF BIOLOGY

Holt, Charles E., III, Ph. D., Associate Professor of Biology
Luria, Salvador E., M. D., D. Sc., Institute Professor of Biology
Magasanik, Boris, Ph. D., Head of Department and Professor of Microbiology
Rich, Alexander, M. D., Professor of Biophysics

To obtain further information, address all inquiries directly to:

Joint Program in Oceanography
Massachusetts Institute of Technology
Room 54-912
Cambridge, Massachusetts

-OR-

Woods Hole Oceanographic Institution
Woods Hole
Massachusetts 02543

MASSACHUSETTS MARITIME ACADEMY
Buzzards Bay, Massachusetts 02532

The Massachusetts Maritime Academy, a member of the Massachusetts system of state colleges, is located at the western end of the Cape Cod Canal at Buzzards Bay. The physical facilities include a classroom building, administration and science building, library, gymnasium and dormitories for 600 students on a 55-acre campus. The SS Bay State, a 416-foot ex-Navy transport provides practical work-study training both at the academy pier and during the annual two-month training cruise. Laboratory facilities serve the academic needs of chemistry, physics, oceanography, electricity, electronics, fluid

dynamics, strength of materials, marine biology, machine shop and diesel engineering. Several small boats provide local practical field trip experiences.

The following degrees are offered:

Bachelor of Science in Marine Engineering
Bachelor of Science in Marine Transportation

Graduates are also qualified for licensed service in the U.S. Merchant Marine and a commission as ensign, USNR

The following courses are offered in conjunction with the above programs:

Mathematics through differential equations	12
Chemistry	6
Physics	9
Mechanics	4
Fluid Mechanics	2
Thermodynamics	4
Strength of Materials	3
Power Engineering (Steam, Diesel, Electrical)	18
Engineering Economics Analysis	2
Graphics	4
Oceanography, introduction	2
Meteorology	3
Physical Oceanography	2
Chemical Oceanography	2
Biological Oceanography	2
Geological Oceanography	2
Oceanographic Instrumentation	2
Ichthyology	2
Marine Ecology	2
Fisheries Economics	2
Fisheries Techniques	2
Fisheries Research	2
Ocean Engineering Structures	2
Marine Hydrodynamics	2
Marine Resources	2
Marine Submersibles	2
Ocean Engineering Instrumentation	2
Computer Science	10
Naval Architecture	4
Admiralty Law	4
Navigation	10

The instructional staff for the courses listed above consists of the following:

Battles, F., Ph.D., Physics
Beninghof, W., Ph.D., Computer Sciences
Cease, J., M.S., Mathematics
Ceely, H., B.S., Meteorology
Charnews, D., M.S., Ocean Engineering
Freedman, C., M.S., Mathematics
Gucwa, K., Ph.D., Chemistry
Kan, D., Ph.D., Oceanography
MacGregor, M., Ph.D., Physics
Nesworthy, J., M.S., Admiralty Law
Northern, H., M.S., Nautical Science
Walsh, M., Ph.D., Engineering
Wright, D., Ph.D., Chemistry

To obtain further information address all inquiries to:

Dr. Frederick J. Hancox, Dean
Massachusetts Maritime Academy
Buzzards Bay, Massachusetts 02532
Telephone: (617) 759-5761

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE
UNIVERSITY OF MIAMI
Miami, Florida 33149

The geographical location of the Rosenstiel School of Marine and Atmospheric Science is unique in many important aspects. The Gulf Stream brings to Miami an essentially tropical environment and offers itself as an ideal object for mass transport studies. Coral reefs grow vigorously off the Florida Keys, providing a living laboratory for the study of numerous species and ecological relationships. The Everglades-Florida Bay ecological system provides a natural laboratory for the study of marine organisms important to fishery science.

The school's seven-acre campus is located on Virginia Key, which is a few miles from downtown Miami and the University of Miami's Coral Gables campus. Virginia Key is connected to the mainland.

The Gilbert Hovey Grosvenor, Agassiz, and Collier buildings house classrooms and research laboratories, which are well equipped for the many needs of modern oceanographic research. These include radiation detection, tritium measurements, mass spectrometry, x-ray diffraction, optical spectroscopy, atomic adsorption, electron microscopy, and carbon-14, potassium-argon, and uranium-thorium dating. The Grosvenor building also houses the catalogued biological research collections which include 27,000 lots and 2,500 species of fishes, and 11,500 lots and 3,700 species of marine invertebrates.

The Alfred C. Glassell, Jr. Laboratory has circulating seawater aquaria throughout and is used for biological research on marine animals, ranging from plankton to sharks. Within its walls, it is possible to reproduce and maintain natural or artificial environments, controllable in such parameters as temperature, salinity, turbidity and pH.

The Henry L. Doherty Marine Science Center, opened in mid-1971, has an auditorium, a computer center, conference rooms, a large dining room, a geological-biological reference center, and houses a library with its 25,000 volumes (books and periodicals) and 21,000 reprints.

The school's Division of Atmospheric Science is housed in the Computer Center at the university's Coral Gables campus, in close proximity to the Radar Meteorological Laboratory. In addition, the facilities of the various schools and departments within the university are available to researchers and students in the school.

Comparative sedimentology, fisheries, and pollution research are carried out at the 14.9-acre Fisher Island Station in Biscayne Bay and the experimental nursery for pink shrimp and pompano is located at Turkey Point, about 30 miles south of Virginia Key. The school also operates a small station at Lerner Laboratory, Bimini, Bahamas.

For research and training in ecology, the university operates two field stations. One is at Pigeon Key, 100 miles south of Miami in the Florida Keys, and the other is in Everglades National Park, about 40 miles from the Coral Gables campus.

The school maintains a fleet of oceanographic research vessels. The largest of the fleet, the 208-foot R/V James M. Gilliss, was assigned in 1971 to the university by the Oceanographer of the Navy. The Gilliss, designed and completely outfitted for deep-sea oceanographic research, has accommodations for 19 scientists and 22 crewmen.

R/V Columbus Iselin was launched in June 1972. An overall 170 feet in length, she has accommodations for 12 scientists and 12 crewmen. The size and range of the Iselin provides an excellent opportunity for "team" oceanographic studies in conjunction with Gilliss in the Straits of Florida, Gulf of Mexico, Caribbean Sea, equatorial Atlantic Ocean and the Pacific Ocean.

R/V Calanus is the school's major shallow-water research vessel. Measuring 62 feet in length, she possesses a maximum draft of approximately five feet. The vessel, with accommodations for five or six research personnel, was commissioned in the fall of 1970. Her research expeditions encompass offshore Miami waters and the Bahamas region.

The 45-foot R/V Orca III, constructed in 1972, provides a work platform for programs in the local Biscayne Bay, Card Sound, Gulf Stream, and nearby reef areas. Although the vessel can accommodate up to 12 scientists on day trips, provisions are not made for overnight cruises due to her limited cruising range.

Because marine science is the application of the classical scientific fields to the marine environment, the school believes that a student's undergraduate training should be designed to give him a broad and thorough background in the "tool" subjects he will later need in his graduate education. For this reason, no undergraduate degree is offered in marine science, and admission to the graduate degree program in marine science requires a B.S. degree in one of the biological or physical sciences. The school offers only three undergraduate courses in marine science: Introduction to Oceanography (PHO201/202), Introduction to Marine Biology (MBS 204/205), and Advanced Marine Biology (MBS 404). In addition, the course, Modern Geology (GEL 312), provides a broad background in the field of marine geology and geophysics.

The following degrees/programs are offered:

1. M.S. degree in Marine Science, with a major in atmospheric science, chemical oceanography, fisheries and applied estuarine ecology, marine biological oceanography, marine geology and geophysics, or physical oceanography. All students are required to complete 30 credits and a thesis representing original research or critical review of literature on a topic approved by the thesis committee. In most cases, an examination demonstrating a reading knowledge of a foreign language (french, german or russian) and a comprehensive examination covering a general understanding of the major field as well as courses taken is required.

2. Ph.D. degree in Marine Science, with a major in atmospheric science, chemical oceanography, fisheries and applied estuarine ecology, marine biological oceanography, marine geology and geophysics, or physical oceanography. All students are required to obtain permission for their advisory committee and petition the academic faculty of the school to enter the Ph.D. program. The student must spend at least two consecutive semesters beyond the first year's graduate work in full-time study at the school. At least 36 graduate credits in courses and seminars are required (they may include courses taken for the M.S. degree, excluding thesis research credits), plus 24 credits of dissertation research. Up to 12 credits may be transferred from other institutions, if approved. In most cases a reading knowledge of two languages and a qualifying examination is required.

3. Certificate Program in Fisheries and Applied Estuarine Ecology. A certificate program is available at the graduate level to provide professional training in various branches of fisheries for foreign students who may not have the academic background or sufficient proficiency in english to undertake advanced degree programs. Students in this program take regular graduate courses and can engage in research projects. They do not need to meet the academic standards required of students who are candidates for advanced degrees, but should achieve at least a C average. Ordinarily the minimum number of credits for completion of the certificate program is 14, but the number of credits and the actual courses chosen will depend on the particular needs of the individual student. A certificate will be given to those who complete the requirements at a satisfactory level of performance. Certificate students who perform well in graduate courses and who wish to do so can be admitted to regular advanced degree programs at the discretion of the faculty. Graduate course credits earned with satisfactory grades under the certificate program will count toward the degree program if students are admitted to the latter.

The following courses are offered in conjunction with the above programs:

ATMOSPHERIC SCIENCE

ATM 501	Atmospheric Electricity	3
ATM 511	Geophysical Fluid Dynamics	3
ATM 518	Theory of Sensors and Systems	3
ATM 531	Physical Meteorology	3
ATM 532	Radar Meteorology	3
ATM 551	Introduction to Atmospheric Science	3
ATM 601-604	Seminar in Atmospheric Science	3
ATM 605-608	Atmospheric Research	2-4
ATM 611	Geophysical Fluid Dynamics II	3
ATM 631	Air-Sea Interaction	3
ATM 632	Planetary Fluid Dynamics	3
ATM 641	Tropical Meteorology	3
ATM 642	Problems in Applied Tropical Meteorology	2
ATM 651	Aeronomy	3
ATM 660	Cloud Physics	3
ATM 661	Synoptic Scale Meteorology	4
ATM 662	Computer Models in Fluid Dynamics	4
ATM 663	Convective and Mesoscale Meteorology	4
ATM 664	Atmospheric Turbulence	4
ATM 665	General Circulation of the Atmosphere	3
ATM 670	Selected Topics in Atmospheric Science	3
ATM 671-679	Advanced Study in Atmospheric Science	2-4
ATM 681-687	Special Work	3

CHEMICAL OCEANOGRAPHY

CHO 503	Fundamentals of Chemical Oceanography	3
CHO 504	Chemical Oceanography Laboratory and Instrumentation	1
CHO 581-582	Supervised Projects	1-4
CHO 603	Advanced Chemical Oceanography	3
CHO 610	Analytical Chemistry in Oceanography	3
CHO 620	Physical-Chemical Oceanography	3
CHO 630	Organic Chemical Oceanography	3
CHO 640	Selected Problems in Chemical Oceanography	4
CHO 660	Atmospheric Chemistry	3
CHO 670	Chemical Oceanography Seminar	1
CHO 680-690	Special Topics in Marine Chemistry	1-4

FISHERIES AND APPLIED ESTUARINE ECOLOGY

FIS 502	Fishery Technology	2
FIS 503	Fishery Biology	3
FIS 521	Saltwater Pollution Technology	3
FIS 581-582	Supervised Projects	1-4
FIS 601-602	Fishery Seminar	1
FIS 603	Fish Stocks and their Management	3
FIS 604	Fish Stocks and their Management Laboratory	1
FIS 605	Population Enumeration and Dynamics	3
FIS 606	Ecology of Marine Parasites	4
FIS 607	Biometrics in Marine Science	4
FIS 608	Economics of Natural Resources	3
FIS 609	Mariculture	3
FIS 671-679	Advanced Study in Fishery Science	1-4
FIS 681-682	Fishery Research	2

MARINE BIOLOGICAL SCIENCE

MBS 204	Introduction to Marine Biology	3
MSB 205	Introduction to Marine Biology Lab	1
MBS 404	Advanced Marine Biology	4
MBS 541	Marine Biochemistry	4
MBS 586	Fishes and their Environment	3
MBS 602	Biological Oceanography Seminar	1
MBS 604	General Biological Oceanography	3
MBS 605	General Biological Oceanography Lab	1
MBS 621	Taxonomy of Marine Invertebrates	4
MBS 622	Ecology of Marine Animals	4
MBS 623	Invertebrate Embryology	4
MBS 625	Behavior of Marine Organisms	4
MBS 626	Advanced Studies in Ethology	2
MBS 630	Marine Microbiology	5
MBS 631	Plankton	4
MBS 632	Phycology	4
MBS 634	Physiology of Marine Organisms	4
MBS 671-679	Advanced Study in Marine Biological Science	1-4

MBS 681-682	Marine Biological Research	2
MBS 687	Systematics of Fishes	4

MARINE GEOLOGY AND GEOPHYSICS

MGG 504	Structural Geology	4
MGG 551	Marine Geology	4
MGG 553	Sedimentation	4
MGG 556	Principles of Micropaleontology	4
MGG 558	Geochemistry	
MGG 560	Application of Modern Physics to Earth Science	3
MGG 561	Geophysics	4
MGG 571	Special Studies	1-4
MGG 581-582	Supervised Projects	1-4
MGG 605	Seminar in Marine Geology and Geophysics	1
MGG 621	Isotopic Processes in Earth Sciences	3
MGG 622	Analytical Methods in Geochemistry	4
MGG 652	Carbonate Sedimentation	3
MGG 653	Advanced Sedimentation	4
MGG 654	Stratigraphic Micropaleontology	4
MGG 655	Paleoecology	3
MGG 658	Advanced Geochemistry and Mineralogy	4
MGG 661	Tectonics	
MGG 662	Morphology and Structure of Ocean Basins	3
MGG 671-679	Advanced Studies in Marine Geology	1-4

PHYSICAL OCEANOGRAPHY

PHO 201	Introduction to Oceanography	3
PHO 202	Ocean and Laboratory Studies in Oceanography	1
PHO 501	Fundamentals of Physical Oceanography	4
PHO 503	Introduction to Physical Oceanography	4
PHO 511	Geophysical Fluid Dynamics	3
PHO 518	Theory of Sensors and Systems	3
PHO 521	Estuarine and Coastal Processes	3
PHO 541	Optical Oceanography	3
PHO 581-584	Supervised Projects	1-4
PHO 601-610	Physical Oceanography Seminar	1
PHO 611	Geophysical Fluid Dynamics II	3
PHO 612	Ocean Circulation Theory	3
PHO 621	Tides and Other Long Waves	3
PHO 625	Advanced Wave Dynamics	3
PHO 631	Air-Sea Interaction	3
PHO 632	Planetary Fluid Dynamics	3
PHO 671-680	Advanced Studies in Physical Oceanography	1-4

The school also offers a joint program in ocean engineering with the School of Engineering and Environmental Design. This program enables engineering graduates to pursue study in ocean engineering and ocean related sciences. The M.S. degree is offered either with a major in ocean engineering or with a major in one of the traditional fields of engineering with a minor in ocean engineering. The areas of specialization in ocean engineering are ocean measurements, underwater acoustics, marine corrosion, underwater structures or coastal engineering. In addition to the M.S. degree program, a qualified student can elect a minor in ocean engineering as part of the Ph.D. program in the Departments of Civil or Mechanical Engineering.

The following courses are offered in conjunction with the above program:

OCEAN ENGINEERING

OEN 502	Introduction to Ocean Engineering	1
OEN 531	Oceanographic Measurements	3
OEN 535	Introduction to Underwater Acoustics	3
OEN 551	Special Problems	1-3
OEN 636	Applied Underwater Acoustics I	3
OEN 654	Random Signals and Noise	3
OEN 671	Underwater Acoustics Laboratory	
OEN 672	Advanced Underwater Acoustics	3
OEN 673	Applied Underwater Acoustics II	3
OEN 675	Applied Ocean Hydronamics	2
OEN 677	Engineering of Ocean Systems	2
OEN 681	Materials in the Marine Environment	2
OEN 682	Marine Corrosion Laboratory	1
OEN 683	Advanced Marine Corrosion	2
OEN 686	Advanced Ocean Measurements	2
OEN 689	Ocean Engineering Seminar	1
OEN 693	Special Topics	1-3
OEN 698	Advanced Topics in Ocean Engineering	1-3

Professional study of the law of the marine environment is offered at two degree levels in the School of Law in an interdisciplinary program with the School of Marine and Atmospheric Science. The area of concentration program offers a specialization in Ocean Law during the three-year period of study for the basic J.D. law degree. For lawyers with a J.D. degree, the LL.M. degree is offered in ocean law to qualify the attorney as an advanced specialist in the legal problems of the ocean environment in preparation for a career in practice, industry or government.

The following courses are offered in conjunction with the above program:

SCHOOL OF LAW

LAW 806	Admiralty	3
LAW 810	The Ocean and its Resources	2
LAW 819	Ocean Law	2-3
LAW 823	Coastal Law	3
LAW 866	International Law	3
LAW 869	Marine Pollution Law	
LAW 985	Ocean Law Seminar	2

SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

FIS 503	Fishery Biology	3
FIS 608	Economics of Natural Resources	3
OEN 689	Ocean Engineering Seminar	2

The instructional staff for the courses listed previously, in the order as presented, consists of the following:

SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE
DIVISION OF ATMOSPHERIC SCIENCE

Estoque, Mariano, Ph.D., Professor
Geisler, John, Ph.D., Associate Professor
Kraus, Eric, Ph.D., Chairman and Professor
Lahiff, Lawrence, Ph.D., Assistant Professor
Latham, Donald, Ph.D., Assistant Professor
Lhermitte, Roger, Ph.D., Professor
Senn, Harry, M.S., Associate Professor
Wenzel, Alan, Ph.D., Assistant Professor

DIVISION OF BIOLOGICAL OCEANOGRAPHY

Bayer, Frederick, Ph.D., Professor
Bunt, John, Ph.D., Chairman, Division of Functional Biology, and Professor
Cooksey, Keith, Ph.D., Associate Professor
Corcoran, Eugene, Ph.D., Associate Professor
deSylva, Donald, Ph.D., Associate Professor
Fell, Jack, Ph.D., Associate Professor
Hine, Alden, Ph.D., Research Scientist
Lane, Charles, Ph.D., Professor
Mitsui, Akira, Ph.D., Professor
Moore, Hilary, Ph.D., Professor
Myrberg, Arthur, Ph.D., Professor
Michel, Harding, Ph.D., Professor
Reeve, Michael, Ph.D., Associate Professor
Robins, Richard, Ph.D., Professor
Stevenson, Robert, Ph.D., Assistant Professor
Taylor, Barrie, Ph.D., Assistant Professor
Taylor, Dennis, Ph.D., Associate Professor
Thomas, Lowell, Ph.D., Associate Professor
Voss, Gilbert, Ph.D., Chairman and Professor
Yang, Won-Tack, Ph.D., Assistant Professor

DIVISION OF CHEMICAL OCEANOGRAPHY

Mattson, James, Ph.D., Assistant Professor
Millero, Frank, Ph.D., Associate Professor
Ostlund, Gote, Ph.D., Professor
Segar, Douglas, Ph.D., Assistant Professor

FISHERIES AND APPLIED ESTUARINE ECOLOGY

Heald, Eric, Ph.D., Assistant Professor
Houde, Edward, Ph.D., Assistant Professor
Iversen, Edwin, Ph.D., Associate Professor
Roessler, Martin, Ph.D., Associate Professor
Runnels, Johnnie, Ph.D., Associate Professor
Tabb, Durbin, Ph.D., Associate Professor

DIVISION OF MARINE GEOLOGY AND GEOPHYSICS

Ball, Mahlon, Ph.D., Professor
Bock, Wayne, Ph.D., Assistant Professor
Bonatti, Enrico, Ph.D., Professor
Bostrom, Kurt, Ph.D., Professor
Emiliani, Cesare, Ph.D., Chairman and Professor
Fisher, David, Ph.D., Professor
Gartner, Stefan, Ph.D., Associate Professor
Ginsburg, Robert, Ph.D., Professor
Harrison, Christopher, Ph.D., Associate Professor
Hay, William, Ph.D., Professor
Honnorez, Jose, Ph.D., Research Scientist
James, Noel, Ph.D., Research Associate
Joensuu, Oiva, Ph.D., Associate Professor
Marszalek, Donald, Ph.D., Research Scientist
Moore, Donald, Ph.D., Assistant Professor
Nagle, Frederick, Ph.D., Associate Professor
Prospero, Joseph, Ph.D., Associate Professor
Rydell, Harold, Ph.D., Research Scientist
Stipp, Jerry, Ph.D., Assistant Professor
Wanless, Harold, Ph.D., Research Scientist

DIVISION OF PHYSICAL OCEANOGRAPHY

Duing, Walter, Ph.D., Chairman and Professor
Gordon, Howard, Ph.D., Associate Professor
Mooers, Christopher, Ph.D., Associate Professor
Perkins, Henry, Ph.D., Assistant Professor
Rooth, Claes, Ph.D., Professor
Van Leer, John, Sc.D., Assistant Professor

DIVISION OF OCEAN ENGINEERING

Compton, Kenneth, M.S., Professor
Craig, H. Lee, Ph.D., Associate Professor
Daubin, Scott, Ph.D., Chairman and Professor
DeFerrari, Harry, Ph.D., Assistant Professor
Michel, John, M.S., Associate Professor
Van der Kreeke, Jacobus, Ph.D., Assistant Professor
Ya'Coub, Kamal, Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Warren J. Wisby
Associate Dean for Graduate Studies
School of Marine and Atmospheric Sciences
University of Miami
10 Rickenbacker Causeway
Miami, Florida 33149

MIAMI-DADE COMMUNITY COLLEGE
Miami, Florida 33132

The present temporary facilities on the Miami River (5,000 square feet) provide the focal point for all marine science technology activity. This facility contains a marine reference center, classroom and laboratory areas, diving areas and instrument room. Besides the indoor facility, the grounds contain facilities to handle our two small boats (22 feet), dockage for our runabouts and 45-foot vessel, and a diving and instrument training tank.

The 45-foot vessel is provided with major electronic equipment, wet laboratory, dry laboratory and considerable deck space aft. It is used to support a coordinated lecture/laboratory/field "hands-on" approach.

The diving/instrument tank provides a means of providing initial training on site independent of weather and vessel schedules. It is primarily used to support the diving program in underwater photography, welding, and other work tasks.

This institution offers three two-year curricula in marine science technology which lead to an Associate in Science degree. These programs are: marine survey technology, marine engineering technology and marine electronics technology.

The marine survey technician would assume responsibilities for the support of engineering and scientific efforts to acquire data at sea. He would be trained in the use of common oceanographic instruments (such as salinity, temperature, and depth recorders) and processing of the data acquired. The work may encompass estuary and coastal areas as well as the open ocean.

The marine engineering technician would assume responsibility for the support of engineering and scientific efforts to perform work on deck and below the water. He would be able to assist in the design, fabrication, installation, and maintenance of equipment in the ocean environment. This person will be trained in SCUBA diving and will perform many of his work tasks such as welding underwater.

The marine electronics technician would assume responsibility for support of engineering and scientific efforts to provide electronic-mechanical instrumentation for use at sea. He would be able to assist the design and provide fabrication, operation and maintenance capability for these instruments.

The following courses are offered in conjunction with the above programs:

OCE 101	Introduction to Oceanography	3
MAO 161	Applied Oceanography	3
MAO 163	Marine Electricity	3
MAO 164	Marine Engineering Practices I	3
MAO 165	Operational Diving	2
MAO 170	Introduction to Oceanography-Lab	1
MAO 180	Marine Engineering Practices II	3
MAO 260	Underwater Operations I	3
MAO 261	Marine Surface Operations	3
MAO 262	Underwater Operations II	3
MAO 263	Ocean Measurements I	3
MAO 280	Advanced Diving	3
MAO 281	Ocean Measurements II	3
MAO 298	Marine Science Internship	3
MAO 299	Marine Science Internship	3

The college also offers a pre-ocean engineering program which prepares the student for entry into the junior year of ocean engineering at Florida Atlantic University. Completion of a four-year program in this area of study will prepare the student for positions as a junior engineer in industry, and for private or government laboratories

engaged in engineering work in the ocean and its environment. The student should consult with an academic advisor regarding details of this program.

The instructional staff for the courses listed above consists of the following:

Bergin, Michael, B.S., Instructor
Cawthon, Stephen, Acting Chairman/Instructor/Diving Officer
LaBonte, Andre, B.S., Instructor
Zawodny, Joseph, B.S., Instructor

To obtain further information, address all inquiries directly to:

Dr. James L. Hoerner, Associate Dean
Occupational Education
Miami-Dade Community College
Downtown Campus
Miami, Florida 33132

THE UNIVERSITY OF MICHIGAN
Ann Arbor, Michigan 48104

The research facilities of the Department of Naval Architecture and Marine Engineering include two ship model basins capable of testing models up to 18 feet long. One basin is 360 feet long, 22 feet wide and 11 feet deep. It is spanned by a traveling carriage that tows the model through the water and carries observers and instrumentation for measuring speed, resistance and so forth. Self-propelled tests are also carried out. The tank is equipped with a false bottom allowing analysis of shallow water effects. It also has a wave-maker allowing model tests in head-on or overtaking waves. The other basin is 100 feet by 60 feet in plan and six feet deep. It is used for ship model tests using radio-controlled, self-propelled models. Although used primarily for maneuvering tests and for sea-keeping tests with waves coming from any direction, it is well suited for mooring studies and other ocean engineering work.

Other facilities include several small instructional items such as a demonstration propeller tunnel. In addition, the department has available to it all the appurtenances of the Engineering College, notably the Fluids Laboratory (110,000 square feet), the Engineering Transportation Library (300,000 volumes) and an IBM 360-67 computer system.

The following degrees are offered:

B.S.E. in Naval Architecture and Marine Engineering (50 degrees awarded in 1971-72). The undergraduate student elects one of three options, each of which leads to the degree, thus acquiring competence in one division of the field while obtaining a good introduction to the rest.

Option 1. Naval architecture relates to the design of ship hulls and includes such topics as form, strength, stability, arrangements, resistance, powering and methods of preliminary design.

Option 2. Marine engineering places emphasis on the design of various types of propelling and auxiliary machinery and on their relation to the ship as a whole.

Option 3. Maritime engineering sciences stresses preparation for research and provides a stronger grounding in basic engineering science with less emphasis on design than that found in the other options. It will be normal for students in this option to spend an extra term and receive an additional degree in mathematics or engineering mechanics or to do graduate work toward an M.S.E. degree from this or other departments

Students may earn an additional B.S.E. degree in either aerospace engineering or industrial engineering under combined programs with the respective engineering departments. The programs allow substantial substitution of courses in one curriculum for those required in the other and typically require one extra term to complete.

Candidates for the degree are required to complete the following program:

Subjects required by all programs, 56 hours, combination of 17 scientific and liberal arts courses, related technical subjects, 21 hours, seven technical courses. Program subjects common to all options, 20 hours, six engineering and design courses. Option 1 (Naval Architecture), 28 hours, 12 courses. Option 2 (Marine Engineering), 28 hours, 11 courses. Option 3 (Maritime Engineering Science), 28 hours, five courses).

M.S. and M.S.E. in Naval Architecture and Marine Engineering (30 degrees awarded in 1971-72). The applicant should have a bachelor's degree (or equivalent education) in engineering, physics or mathematics. Preparation should include introductory courses in differential equations, solid mechanics, fluid mechanics and dynamics. Some experience with a large digital computer is desirable.

The 30 credit hours required for the degree will normally include at least 15 hours in naval architecture and marine engineering beyond those required for the bachelor's degree, as well as five or more hours of graduate-level mathematics courses.

There are no specific courses required of all students at this level. Most students will specialize in one or more of the following areas, including in their programs the basic courses specified: ship hydrodynamics, ship structures, marine engineering, ocean engineering or marine systems.

The programs leading to the M.S.E. degree are intended to train students for careers in design, shipyard practice and management. Applicants for these programs should have obtained the B.S.E. degree in naval architecture and marine engineering, or they should have some experience in the marine field in addition to a bachelor's degree in some other field of engineering. The M.S.E. degree is logically followed by one of the professional degrees. Students anticipating careers in research, development and teaching will normally work for the M.S. degree, which may then be followed by the Ph.D. degree.

The graduate advisor may allow certain courses in other departments to be used in partial fulfillment of the requirement of 15 hours in naval architecture and marine engineering, depending upon the background and goals of the individual student. The program in Marine Systems, Operations and Design is normally open only to applicants with a bachelor's degree or equivalent experience in the marine field.

Naval Architect, Marine Engineer (professional degrees) (no degrees awarded in 1971-72). The professional degree program requires a minimum of 30 credit hours of work beyond the M.S.E. level or its equivalent, taken at this university with a grade average of B or better. Successful completion of a qualifying examination for admission to candidacy is required.

The total graduate program shall include: at least 24 hours in the area of the department or program cited in the degree. The department or program advisors may specify these hours in greater detail. At least six hours devoted to research, design, or development problem, including a written report covering the work. A committee of faculty members will supervise the work, approve the report and conduct a final oral examination on this work. At least three courses in cognate fields other than mathematics. At least nine hours in mathematics beyond the B.S.E. mathematics requirements of the department cited in the degree.

Ph.D. (two degrees awarded in 1971-72). The Ph.D. degree is conferred in recognition of marked ability and scholarship in some relatively broad field of knowledge. A part of the work consists of regularly announced gradu-

ate courses of instruction in the chosen field and in such cognate subjects as may be required by the student's committee. In addition, the student must pursue independent investigation in some subdivision of the selected field and must present the result of his investigation in the form of a dissertation.

A student becomes an applicant for the doctorate when he has been admitted to the Horace H. Rackham School of Graduate Studies and has been accepted in the field of his specialization. No assurance is given that he may become a candidate for the doctorate until he has given evidence of superior scholarship and ability as an original investigator.

There is no general course or credit requirement for the Ph. D. degree. A student must pass a comprehensive examination in his major field or specialization, which tests his knowledge in that field and in the supporting fields, before he will be recommended for candidacy for the doctorate. A special doctoral committee is appointed for each applicant to supervise the work of the student both as to election of courses and in preparation of the dissertation.

A pamphlet that describes the general procedure leading to the doctorate can be obtained from the Graduate School office upon request, and another for this department specifically is also available.

The following courses are offered in conjunction with the above programs:

200	Introduction to Naval Architecture	4
300	Computer Techniques in Naval Architecture	2
310	Structural Design I	3
330	Marine Engineering I	4
331	Marine Engineering II	3
350	Ocean Engineering I	3
400	Maritime Engineering Management	2
401	Small Craft Design	2
402	Small Commercial Vessel Design	2
403	Sailing Craft Design Principles	2
410	Stress Analysis of Ship Structures	3
420	Resistance, Propulsion and Propellers	4
430	Marine Engineering	3
431	Marine Engineering III	3
440	Ship Dynamics	3
446	Theory of Ship Vibrations I	3
450	Ocean Engineering II	3
469	Underwater Operations	3
470	Ship Design I	3
475	Design Project	3
490	Directed Study, Research and Special Problems	--
510	Ship Structure Analysis I	3
511	Directed Research in Ship Structure	--
520	Advanced Ship Model Testing	2-3
521	Research in Ship Hydrodynamics	--
525	Naval Hydrodynamics I	3
526	Naval Hydrodynamics II	3
528	Water Waves	3
530	Theory of Ship Vibrations II	2
535	Propulsion Plant Design Decisions	3
550	Ocean Engineering III	--
571	Advanced Ship Design	--
572	Economics of Ship Design	3
573	Maritime Management	3
574	Computer-Aided Ship Design	3
590	Advanced Reading Seminar in Marine Engineering	--
591	Advanced Reading and Seminar in Naval Architecture	--
592	Master's Thesis	3
610	Finite Element Methods	3
615	Ship Structure Analysis III	--
620	Advanced Propeller Theory and Cavitation	2
625	Naval Hydrodynamics III	--
900	Doctoral Thesis	--

The instructional staff for the courses listed above consists of the following:

Beck, R. F., Ph. D., Assistant Professor of Naval Architecture and Marine Engineering
Benford, H., B. S. E., Professor of Naval Architecture and Marine Engineering
Conch, R. B., Ae. E., Professor of Naval Architecture and Marine Engineering
D'Arcangelo, A. M., M. S., Professor of Naval Architecture and Marine Engineering
Kaldjian, M. J., Ph. D., Associate Professor of Naval Architecture and Marine Engineering
Melvor, I. K., Ph. D., Professor of Engineering Mechanics and Acting Chairman of the Department of Naval Architecture and Marine Engineering
Nowacki, H. G., Dr.-Ing., Associate Professor of Naval Architecture and Marine Engineering
Ogilvie, T. F., Ph. D., Professor of Fluid Mechanics Department of Naval Architecture and Marine Engineering
Parsons, M. G., Ph. D., Assistant Professor of Naval Architecture and Marine Engineering
Woodward, J. B. III., Ph. D., Associate Professor of Naval Architecture and Marine Engineering

To obtain further information, address all inquiries directly to:

Professor Horst Nowacki
Department of Naval Architecture and Marine Engineering
West Engineering Building
Ann Arbor, Michigan 48104

Interdisciplinary programs of advanced study in water resources in the College of Engineering are centered in the Department of Civil Engineering. These include degree programs leading to the degree Master of Science in water resources sciences, M. S. E. degree in civil engineering: water resources; M. S. degree in water resources management; and the degree of Doctor of Philosophy in civil engineering: water resources. For further information, contact Professor Walter J. Weber, Chairman of the Water Resources Program, College of Engineering, University of Michigan, Ann Arbor, Michigan 48104.

The Department of Atmospheric and Oceanic Science includes laboratories for atmospheric and marine chemistry, synoptic meteorology, geophysical fluid dynamics, meteorological instrumentation, upper atmosphere studies, and facilities for general physical oceanography and submarine geology.

The Great Lakes Research Division of the university's Institute of Science and Technology maintains and operates research facilities for studies of the Great Lakes. These include research vessels and campus laboratories, both of which are available for staff and student field studies in oceanography. Though the Great Lakes Research Division is a research facility not directly involved with teaching, it assists in the educational program through the research of faculty and students.

Many of the oceanography staff of the Department of Atmospheric and Oceanic Science are participants in the university's Sea Grant Program. Sea Grant activities, currently centered on a region of Lake Michigan, involve field studies of sediment chemistry, basin morphology, shallow and deep currents, and local meteorology, complemented with mathematical simulation studies of these same phenomena.

Other recent research activities of faculty and students in oceanography include: air-sea interaction phenomena, circulation and diffusion processes, sediments and sedimentation processes, air-mass modification, water quality modification by man's wastes, geological structure of the Great Lakes basins, Great Lakes climatology, ecology of plankton, and benthic organisms, as well as waves and wave prediction. There is also an active program of underwater operations aimed at developing research capabilities and contributions.

The following degrees are offered by the Department of Atmospheric and Oceanic Science:

M.S. in Oceanic Science. An applicant for the M.S. degree in oceanic science is expected to hold a bachelor's degree and to have completed requirements in mathematics and physics. The bachelor's degree may be in any field of specialization, but students without undergraduate courses in oceanic science may be required to make up for this deficiency by completing such undergraduate courses as specified by their advisor.

Requirements for the degree include 30 credit hours of graduate studies approved by one of the graduate advisors, consisting of a minimum of at least 15 credit hours of course work in oceanic science and a minimum of six credit hours of mathematics or three hours of mathematics and three hours of cognative science.

The student's program will be adjusted to assure that the student obtains some proficiency in each of several core subject matter areas. For oceanic science, these core areas are physical and dynamical oceanography, oceanographic observations and data analysis, marine chemistry and marine geology. Six hours of course work in oceanic science may, after agreement with the graduate advisor, be replaced by a master's thesis.

Ph. D. in Oceanic Science. An applicant for the degree of Doctor of Philosophy in oceanic science is expected to have ability and scholarship of a high order. The student must be able to satisfy core requirements specified for the master's degree at a high level of competence and will elect additional courses to supplement his background and provide him with the knowledge and techniques needed to carry out independent investigations.

To satisfy the departmental requirements for candidacy, the student must successfully pass a preliminary examination. The student must also satisfy the departmental language requirement of basic reading competence in one foreign language (french, german or russian) or substitute six hours of humanities or social science.

When the student has become a candidate, a dissertation committee will be appointed for the student by the chairman of the department. The subject of the dissertation may be in any area of oceanic science that is approved by the dissertation committee. A satisfactory oral examination of the candidate on the dissertation and related material, conducted by the dissertation committee, completes the requirements for the degree.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

304	Introduction to Atmospheric and Oceanic Sciences I	3
305	Introduction to Atmospheric and Oceanic Sciences II	3
306	Laboratory in Geophysical Data I	2
307	Laboratory in Geophysical Data II	1
325	Introduction to Biological Oceanography	3
331	Thermodynamics of the Atmospheres and Oceans	3
333	Physical Oceanography	3
350	Ocean Engineering I	3
351	Geophysical Fluid Dynamics	3
360	Oceanography Field Methods	8

GRADUATE

417	Geology of the Great Lakes	2
442	Oceanic Dynamics I	4
444	Geophysical Fluid Models	3
449	Marine Geology	4
450	Ocean Engineering II	3
469	Underwater Operations	3
472	Experimental Marine and Mineral Geochemistry	2
478	Marine Chemistry	4
526	Dynamics of the Oceans and Atmosphere	3
528	Water Waves	3
531	Marine Ecology	4
542	Oceanic Dynamics II	3
543	Oceanic Dynamics III	3
550	Ocean Engineering III	--
559	Measurements in Physical Oceanography	3
560	Oceanography Field Practicum	8
572	Marine Geochemistry	3
605	Current Topics in Meteorology and Oceanography	3
701	Special Problems in Meteorology and Oceanography	--
990	Dissertation/Precandidate	2-8
995	Dissertation/Candidate	6

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF ATMOSPHERIC AND OCEANIC SCIENCE

Ayers, J.C., Ph.D., Professor
Baker, D.G., Ph.D., Assistant Professor
Bartman, F.L., Ph.D., Associate Professor
Baer, F., Ph.D., Professor
Callender, E., Ph.D., Assistant Professor
Dingle, A.N., Sc.D., Professor
Drayson, S.R., Ph.D., Assistant Professor
Epstein, E.S., Ph.D., Chairman and Professor
Gill, G.C., M.A., Professor
Green, A.W., Jr., Ph.D., Assistant Professor
Hays, P.B., Ph.D., Associate Professor
Hough, J.L., Ph.D., Professor
Jacobs, S.J., Ph.D., Associate Professor
Jones, L.M., Ph.D., Professor
Kuhr, W.R., Ph.D., Associate Professor
Meyers, P.A., Ph.D., Assistant Professor
Monahan, E.C., Ph.D., Associate Professor
Moses, H., Ph.D., Adjunct Professor
Portman, D.J., Ph.D., Professor
Wiin-Nielsen, A.C., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Dr. Edward S. Epstein, Chairman
Department of Atmospheric and Oceanic Science
4072 East Engineering Building
The University of Michigan
Ann Arbor, Michigan 48104
(313) 763-2390

MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48823

Michigan State University has research and teaching facilities for work in limnology and oceanography on the main campus in East Lansing and at the W.K. Kellogg Biological Station at Hickory Corners, Michigan. In addition, use is made of the nearby Great Lakes and of affiliations with several marine stations.

Facilities on the main campus are available through the Departments of Fisheries and Wildlife and Geology. The facilities include numerous laboratories with standard analytical equipment; a special laboratory with 19 ponds for controlled experiments on the bands of the Red Cedar River on the main campus; a nuclear reactor; an automated, multichannel gamma counter for neutron activation analysis and isotope analyses; a scanning electron microscope; an electron microprobe; an X-ray diffraction meter; X-ray fluorescence equipment; an infrared spectrometer; a coulter counter; chromatographs, a seismic play-back center; bomb calorimeter; and a carbon analyzer. Field equipment includes a 20-foot launch and many smaller boats; biological-, sediment- and

water-sampling devices; magnetometers; gravity meters; a seismic van and requisite support equipment. The W. K. Kellogg Biological Station is a separate entity affiliated through teaching and research programs with the College of Natural Science. Courses are offered during the summer session and research conducted throughout the year. Laboratory and boat facilities are duplicated at the station.

The following degrees are offered:

B.S. in Fisheries and Wildlife, specializing in fishery biology and limnology. Requirements: 43 credits in the social sciences and humanities; completion of credits in biological sciences, chemistry, geology, mathematics, physics and soil science; 40 to 43 credits in professional core curriculum for specialty, and 23 to 49 other elective credits.

M.S. in Fisheries and Wildlife, specializing in fish management, fishery biology, limnology or pollution biology. Requirements: completion of 45 credits past the bachelor's degree of which 8 to 22 hours must be in research and completion and defense of a master's thesis.

Ph.D. in Fisheries and Wildlife, with specialties above. Requirements: completion of a minimum of 36 credits above the equivalent of a master's degree; 12 credits in thesis research and successful completion of a dissertation; competence in one or two of the following areas for which nine credit hours may be taken: education, communications, foreign language, computer science, systems science, philosophy, mathematics or any other discipline acceptable to the student's committee, and oral or written examinations for degree candidacy and for defense of the dissertation.

B.S. in Geology, with specialization in marine geology, geophysics or geochemistry. Requirements: 60 non-science credits; mathematics through Calculus III or Calculus II plus a course in statistics; chemistry equivalent to three quarters of study; 12 credits in physics; geology courses and a total of at least 180 hours. Courses in marine and aquatic sciences offered in fisheries and wildlife are considered as non-science electives and are strongly encouraged.

M.S. in Geology with specialization in marine geology, geophysics or geochemistry. Requirements: minimum of 45 credits of which up to 10 can be for thesis research and completion and defense of a master's thesis.

M.A.T. in Geology with specializations as above. Requirements: Candidates must have a teaching certificate prior to receipt of the degree, a minimum of 45 credits, in addition to those required for the teaching certificate, and successful completion of a comprehensive examination, oral or written.

Ph.D. in Geology with specializations as above. Requirements: completion of a suitable curriculum as determined by the candidate and his guidance committee, completion of a foreign language requirement or a suitable substitute as approved by the guidance committee, oral and/or written examinations for degree candidacy, which must be passed prior to initiation of dissertation research, and for defense of the dissertation, and successful submission of a dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

FW 374	Biological Oceanography	3
FW 471	Ichthyology	3
FW 473	Fishery Biology and Management	5
FW 476	Limnology	3
FY 477	Limnological Methods	3
GLG 201	General Geology - Physical	4
GLG 202	General Geology - Historical	4
GLG 205	Oceanology: The Marine Environment and Man	3
GLG 400H	Honors Work	--
GLG 432	Introduction to Meteorology	3
GLG 433	Introductory Meteorology Lab	1
GLG 445	Field Studies	--
GLG 474	Geophysical Methods	4
GLG 475	Geophysics	3
GLG 492	Sedimentology I	3
GLG 493	Sedimentology II	3
GLG 495	Geochemistry I	3
GLG 496	Geochemistry II	3

GRADUATE

FW 802	Chemical Limnology	3
FW 874	Advanced Biological Limnology	3
FW 899	Research - Master's	--
FW 999	Research - Doctoral	--

Additional courses are available in the Departments of Civil and Sanitary Engineering, Botany, Zoology, Resource Development and Physics that may be applied to the student's curriculum in order to allow specialization in any of the subdivisions in marine science.

The instructional staff for the courses listed above consists of the following:

FISHERIES AND WILDLIFE

Bahr, T.G., Ph.D., Assistant Professor
Ball, R.C., Ph.D., Professor and Director of the Institute of Water Research
D'Itri, F.M., Ph.D., Assistant Professor
Kevern, N.R., Ph.D., Professor and Chairman
McNabb, C.D., Ph.D., Associate Professor
Roelofs, E.W., Ph.D., Professor
Tack, P.I., Ph.D., Professor

GEOLOGY

Anstey, R.L., Ph.D., Assistant Professor
Bennett, H.F., Ph.D., Assistant Professor
Carmichael, R., Ph.D., Assistant Professor
Cross, A.T., Ph.D., Professor
Ehrlich, R., Ph.D., Associate Professor
Fisher, J.H., Ph.D., Professor
Spooner, C.M., Ph.D., Assistant Professor
Upchurch, S.B., Ph.D., Assistant Professor

W.K. KELLOGG BIOLOGICAL STATION

Cummins, K.W., Ph.D., Associate Professor
Hall, D.J., Ph.D., Associate Professor
Klug, M.J., Ph.D., Assistant Professor
Lauff, G.H., Ph.D., Professor and Director
Wetzel, R.G., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Chairman
Department of Geology
Michigan State University
East Lansing, Michigan 48823

MISSISSIPPI STATE UNIVERSITY
Mississippi State, Mississippi 39762

Mississippi State University has teaching and research facilities at the main campus and is affiliated with Mississippi's Gulf Coast Research Laboratory located at Ocean Springs, Mississippi. At the main campus, facilities consist of classrooms, laboratories, computers, and offices.

The following degrees are offered:

College of Engineering, Institute of Engineering Tech-

nology: Bachelor of Engineering Technology (marine engineering technology). Requirement: 130 semester hours; degrees conferred in 1971-72, six.

College of Arts and Sciences: Master of Science with marine specialties in botany, geology, microbiology or zoology. Requirements: 30 semester hours, one foreign language and thesis. Ph. D. with marine specialties in botany, microbiology or zoology. Requirements: varied coursework, minimum of one foreign language and dissertation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

BOT 1003	General Botany
BOT 1013	General Botany I
BOT 1023	General Botany II
Bot 1083	Honors General Botany I
BOT 1093	Honors General Botany II
CET 3023	Marine Structures
GET 2303	Applied Thermodynamics
GET 2403	Metals Technology
GET 2503	Oceanography I
GET 2603	Oceanography II
GET 3003	Introduction to Underwater Acoustics
GET 3323	Applied Dynamics
GG 1001	Geology I Laboratory
GG 1003	Geology I
GG 1021	Geology II Laboratory
GG 1023	Geology II
GG 1093	Honors in Physical Geology
GG 2053	Advanced General Geology
GG 3033	Introduction to Environmental Geology
MAT 2004	Shipbuilding Technology I
MAT 2104	Marine Engineering Technology I
MAT 2603	Naval Architecture Technology I
MAT 3014	Shipyard Operations Technology I
MAT 3024	Shipbuilding Technology II
MAT 3114	Marine Engineering Technology II
MAT 3123	Marine Engineering Technology III
MAT 3404	Shipboard Ventilation
MAT 3614	Naval Architecture Technology II
MAT 3623	Naval Architecture Technology III
MIC 1113	Elementary Microbiology
MIC 1214	General Microbiology
MIC 2424	Bioinstrumentation
ZO 1001	Biological Science Laboratory
ZO 1003	Introduction to Biological Science
ZO 1094	Honors in General Zoology
ZO 1314	Invertebrate Zoology
ZO 2614	Biology of Vertebrates
ZO 3014	Introduction to Marine Zoology
ZO 3115	Vertebrate Morphology I
ZO 3125	Vertebrate Morphology II
ZO 3714	Ecology
ZO 3813	Biological Techniques
ZO 4000	Special Problems

UNDERGRADUATE/GRADUATE

BOT 4103/6103	Taxonomy of Spermatophytes
BOT 4114/6114	General Plant Physiology
BOT 4133/6133	Plant Ecology
BOT 4904/6904	Introduction to Marine Botany
BOT 5103/7103	Cytology
GG 4303/6303	Introduction to Stratigraphy and Sedimentation
GG 4413/6413	Physical Marine Geology
GG 4423/6423	Chemical Marine Geology
GG 4503/6503	Geomorphology
GG 4603/6603	Engineering Geology
GG 5323/7323	Gulf Coast Stratigraphy
MIC 4424/6224	Advanced General Microbiology
MIC 4321/6231	Microbiological Literature
MIC 4324/6324	Microbiology of Water and Sewage
MIC 4413/6413	Quantitative Microbiology I
MIC 5213/7213	Microbial Physiology I
MIC 5223/7223	Quantitative Microbiology II
MIC 5414/7414	Radioisotope Techniques I
ZO 4326/6326	Marine Invertebrate Zoology
ZO 4636/6636	Marine Vertebrate Zoology and Ichthyology
ZO 4824/6824	Marine Fisheries Biology

GRADUATE

BOT 7000	Special Problems
BOT 8000	Thesis Research/Thesis
BOT 8104	Morphology of Algae
BOT 8112	Botanical Literature
BOT 8124	Advanced Anatomy
BOT 8144	Cytogenetics
BOT 8163	Advanced Plant Physiology I
BOT 8173	Advanced Plant Physiology II
BOT 8801-8821	Seminar
BOT 9000	Dissertation Research/ Dissertation
GG 7000	Special Problems
GG 8000	Thesis Research/Thesis
GG 8064	Earth Sciences I
GG 8074	Earth Sciences II
GG 8333	Sedimentology
GG 8551-8561	Graduate Seminar
GG 8572	Geologic Literature
GG 8623	Special Topics in Geology
GG 9163	Sedimentary Petrology
MIC 7000	Special Problems
MIC 8000	Thesis Research/Thesis
MIC 8201-8211	Seminar
MIC 8235	Mathematical Microbiology
MIC 8253	Quantitative Microbiology III
MIC 8293	Microbial Genetics
MIC 8324	Applied Microbiology
MIC 8414	Radioisotope Techniques II
MIC 9000	Dissertation Research/ Dissertation
ZO 7000	Special Problems
ZO 8000	Thesis Research/Thesis
ZO 8213	Comparative Physiology
ZO 8314	Advanced Invertebrate Zoology
ZO 8633	Vertebrate Ethology
ZO 8713	Advanced Ecology
ZO 8802	Scientific Writing for Biological Students
ZO 8811-8831	Seminar
ZO 8943/8993	Special Topics in Zoology
ZO 9000	Dissertation Research/ Dissertation

The instructional staff for the courses listed above consists of the following:

MARINE ENGINEERING TECHNOLOGY

Anderson, C. F., M. S., Associate Professor of Marine Engineering Technology
Bartlett, F. G., M. S. E., Associate Professor of Marine Engineering Technology
Benton, R. D., M. S., Associate Professor of Electrical Engineering Technology
Bryant, G. B., M. S., Assistant Professor of Marine Engineering Technology
Thomas, J. E., M. S., Director of Institute of Engineering Technology and Professor of Electrical Engineering

BOTANY

Hare, M. L., Ph. D., Assistant Professor
Johnston, G. W., Ph. D., Professor and Department Head
Lane, H. C., Ph. D., Adjunct Associate Professor
Locke, J. F., Ph. D., Professor
McDaniel, S. T., Ph. D., Assistant Professor
Price, J. A., Jr., Ph. D., Assistant Professor
Watson, J. R., Jr., Ph. D., Associate Professor

GEOLOGY

Laswell, T. J., Ph. D., Professor of Geology and Geography and Head of the Department
Lins, T. W., Ph. D., Assistant Professor of Geology and Geography
Keady, D. M., Ph. D., Associate Professor of Geology and Geography
Russell, E. E., Ph. D., Professor of Geology and Geography

MICROBIOLOGY

Brown, L. R., Ph. D., Assistant Dean of Arts and Sciences and Professor of Microbiology
Cook, D. W., Ph. D., Assistant Professor of Microbiology
McCamish, J., Ph. D., Associate Professor of Microbiology
Mickelson, J. C., Ph. D., Professor of Microbiology
Stojavonic, B. J., Ph. D., Professor of Agronomy
Tischer, R. G., Ph. D., Professor of Microbiology and Head of the Department
Wang, A. W. S., Ph. D., Assistant Professor of Microbiology

ZOOLOGY

Altig, R. G., Ph. D., Assistant Professor
Clemmer, G. H., Ph. D., Assistant Professor
Cross, W. H., Ph. D., Adjunct Professor
De La Cruz, A. A., Ph. D., Associate Professor
Dawson, C. E., B. S., Adjunct Associate Professor
Morrow, J. T., Ph. D., Professor and Head of the Department
Yarborough, J. D., Ph. D., Professor

For additional information, address all inquiries directly to:

Marine Engineering Technology
J. E. Thomas, Director
Institute for Engineering Technology
P. O. Drawer GL
Mississippi State, Mississippi 39762
(601) 325-3073

Marine Science Programs
J. C. McKee, Jr.
Vice President for Research and Dean of the Graduate School
P. O. Drawer G
Mississippi State, Mississippi 39762
601-325-4325

NAVAL POSTGRADUATE SCHOOL
Monterey, California

The Department of Oceanography offers graduate education in oceanography for active duty military officers. The department operates a 126-foot hydrographic research vessel and ships from the Pacific oceanographic vessel pool. Laboratory facilities include a small sediments laboratory, a biological laboratory, as well as chemical and geological laboratories. Also utilized are facilities in the Departments of Electrical Engineering, Physics, Mechanical Engineering and Material Science and Chemistry.

The degree of Master of Science in Oceanography is offered. Requirements: entrance requires a baccalaureate degree in a field appropriate to the oceanography option chosen. Minimal requirements include mathematics through differential and integral calculus, one year of college physics, and one year of college chemistry.

Completion of 35 quarter hours of graduate courses of which 15 hours must be in the 4000 oceanography series. The entire sequence of courses for the particular program selected must be approved by the Department of Oceanography. Also, an acceptable thesis on a topic approved by the Department of Oceanography.

The degree of Master of Science in Engineering Acoustics is offered as an interdisciplinary program with courses drawn principally from the fields of electrical engineering and physics. The emphasis is on those aspects of acoustics concerning propagation of sound in water, in applications of underwater sound, and on the electrical engineering of instrumentation for underwater sound detection. Between six and 10 students are graduated each year. Degree requirements are: preparation: completion of work which would qualify the student for a Bachelor of Science degree in engineering or physical sciences, minimum of 36 graduate credit quarter hours must be taken in acoustics and its applications; one 4000 level course from each of the three following areas must be included: wave propagation, vibration and noise control, transducer theory, sonar systems, and signal processing, and an acceptable thesis must be completed.

The following courses are offered in conjunction with the above programs:

UPPER DIVISION

OC	2110	Introduction to Oceanography	3

UPPER DIVISION OR GRADUATE

OC	3150	Geophysical Random Processes	5
OC	3221	Descriptive Oceanography	4
OC	3250	Dynamical Oceanography	4
OC	3260	Sound in the Ocean	3
OC	3320	Geological Oceanography	4.5
OC	3420	Biological Oceanography	4.5
OC	3520	Chemical Oceanography	4
OC	3601	Ocean Wave Forecasting	3
OC	3605	Ocean Wave Forecasting Laboratory	3
OC	3611	Ocean Wave and Surf Forecasting	2
OC	3615	Ocean Wave and Surf Forecasting Lab	3
OC	3616	Oceanographic Forecasting	3
OC	3621	Oceanographic Forecasting Lab	2
OC	3700	Oceanographic Instrumentation and Observations	3
OC	3710	Field Experience in Oceanography	2
OC	3801	Ocean Operations I	3.5

GRADUATE

OC	4211	Waves and Tides	4
OC	4213	Coastal Oceanography	4.5
OC	4251	Dynamical Oceanography I	4
OC	4252	Dynamical Oceanography II	4
OC	4253	Dynamical Oceanography III	3
OC	4260	Sound in the Ocean	3
OC	4340	Marine Geophysics	3
OC	4421	Marine Ecology	3
OC	4422	Marine Fouling	1.5
OC	4612	Polar Oceanography	3
OC	4800	Special Topics in Oceanography	3
OC	4802	Ocean Operations II	3.5
OC	4803	Physical Properties of Marine Sediments	3.5
OC	4851	Geophysics: Earth Gravity	4
OC	4852	Geophysics: Earth Magnetism and Electricity	4
OC	4853	Geophysics: Sound and Seismicity	4
OC	4900	Seminar in Oceanography	3
OC	4901	Seminar in Ocean Operations	3

DEPARTMENT OF ELECTRICAL ENGINEERING

EE	2114	Communication Theory I	4
EE	3116	Communication Theory II	4

EE	3311	Energy Conversion	4
EE	3622	Electromagnetic Theory	3
EE	3731	Instruments and Equipment for Ocean Operation	5.5
EE	4451	Sonar Systems Engineering	4
EE	4452	Underwater Acoustic System Engineering	5
EE	4541	Signal Processing	3.5
EE	4571	Statistical Communications Theory	4
EE	4581	Information Theory	3.5

DEPARTMENT OF PHYSICS

PH	3157	Physics of Continua	4
PH	3431	Physics of Sound in the Ocean	5
PH	3451	Fundamental Acoustics	4.5
PH	3452	Underwater Acoustics	5
PH	4453	Propagation of Waves in Fluids	4
PH	4454	Transducer Theory and Design	4

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF OCEANOGRAPHY

Andrews, Robert S., Ph. D., Assistant Professor
Bechelmeyr, L. R., Cdr., USN, Instructor
Boston, Noel E. J., M. S., Associate Professor
Denner, Warren W., Ph. D., Assistant Professor
Galt, Jeery A., Ph. D., Assistant Professor
Haderlie, Eugene C., Ph. S., Professor
Jung, Glenn H., Ph. D., Professor
Leipper, Dale F., Ph. D., Chairman and Professor
Roberts, Cahrles R., LCDR, USN, Instructor
Thompson, Warren C., Ph. D., Professor
Thornton, Edward B., Ph. D., Assistant Professor
Traganza, Eugene D., Ph. D., Assistant Professor
Von Schwind, Joseph J., Ph. D., Associate Professor
Wickham, Jacob B., M. S., Associate Professor

The Engineering Acoustics Program is administered in the Department of Physics and Chemistry. An engineering acoustics academic committee monitors the academic content of the program, it consists of:

Sackman, G. L., Ph. D., Associate Professor of Electrical Engineering
Wilson, O. B., Jr., Ph. D., Professor of Physics and Committee Chairman

Other professors involved with the program include:

Coppens, A. B., Ph. D., Associate Professor of Physics
Eller, A. I., Ph. D., Assistant Professor of Physics
Medwin, H., Ph. D., Professor of Physics
Myers, G. A., Ph. D., Associate Professor of Electrical Engineering
Sanders, J. V., Ph. D., Associate Professor of Physics
Stentz, D. A., M. S., Associate Professor of Electrical Engineering
Titus, H. A., Ph. D., Professor of Electrical Engineering

To obtain further information, address all inquiries directly to:

Dr. Dale F. Leipper, Chairman
Department of Oceanography
Naval Postgraduate School, Code 58
Monterey, California 93940

UNIVERSITY OF NEW HAMPSHIRE
Durham, New Hampshire 03824

The University of New Hampshire has natural facilities for marine studies. The Great Bay estuarine systems is adjacent to the campus. The coastline of the open Atlantic is less than 15 miles away with the Isles of Shoals a few miles offshore.

An 8,400-square-foot research facility, the Jackson Estuarine Laboratory, is located on Great Bay. This facility is maintained primarily for use by marine-oriented faculty and students of the university. The 45-foot R/V Jere A. Chase and several other university research vessels are docked at the laboratory. The Chase is equipped with a recording fathometer, radios, radar and a Loran. Equipment at the Jackson Estuarine Laboratory and on the campus includes running seawater systems, electron microscopes, digital computers, a Beckman automatic amino acid analyzer, liquid scintillation counter, wave tank, an underwater sound laboratory and a mass spectrometer.

The Departments of Biochemistry, Botany, Earth Sciences, Microbiology and Zoology are heavily committed to marine research. In addition, marine-oriented research is conducted in the Departments of Physics, Chemistry and Resource Economics. Marine research programs at the university include studies in the marine food web, marine biotoxins, chemical and biological pollution, physical, chemical and geological oceanography, marine mineral resources, marine resources management and mariculture. Much of this research is conducted in the estuary and on the continental shelf. The Scuba and water safety programs in the Department of Physical Education are closely coordinated with the entire campus-wide marine program.

Oceanography at the University of New Hampshire is multidisciplinary. Students wishing to prepare themselves for careers in oceanography or marine sciences enroll as a major in an existing department. The ocean-oriented content of the program is arranged in consultation with the academic advisors in the various departments. Students will find ample opportunity to participate in the broad spectrum of marine research in the life sciences, physical sciences, or engineering, all in progress at the university.

The following degrees are offered:
Department of Biochemistry: B.S., M.S., Ph.D.
Department of Botany: B.S., M.S., Ph.D.
Department of Earth Sciences: B.A., B.S. (Geology), M.S. (Earth Sciences - Option in Oceanography)
Department of Microbiology: B.A., M.S., Ph.D.
Department of Zoology: B.A., M.S., Ph.D.

The following courses are in conjunction with the above programs:

BIOLOGY

641	Principles of Ecology	4

BOTANY

723	Introduction to Biological Oceanography and Marine Ecology	4
722	Marine Phycology	4
822	Advanced Marine Phycology	4

MICROBIOLOGY

707	Marine Microbiology	4

ZOOLOGY

618	Introductory Invertebrate	4
704	Comparative Endocrinology	4
711	Natural History of Cold-Blooded Vertebrates	4
715	Natural History of Marine Invertebrates	4
772	Fisheries Biology	4
796	Invertebrate Endocrinology	4
803	Marine Ecology	4
820	Invertebrate Zoology	4
821	Invertebrate Zoology	4
822	Protozoology	4
823	The Host-Parasite Relationship	4

826	Comparative Physiology	4
830	Invertebrate Embryology	4

EARTH SCIENCES

501	Introduction to Oceanography	4
734	Applied Geophysics	4
741	Geochemistry	4
752	Chemical Oceanography	4
754	Sedimentation - Stratigraphy	4
759	Geological Oceanography	4
795	Topics in Physical Oceanography	4
816	Clay Mineralogy	4
856	Estuarine and Marine Sedimentation	4

An introductory course in marine science is given during the summer at the Isle of Shoals in cooperation with Cornell University and the State University of New York at Stony Brook.

The instructional staff for the courses listed above consists of the following:

LIFE SCIENCE

Borror, Arthur C., Ph.D., Associate Professor of Zoology
Bullock, Wilbur L., Ph.D., Professor of Zoology
Chesbro, William R., Ph.D., Professor of Microbiology
Croker, Robert A., Ph.D., Assistant Professor of Zoology
Green, D. MacDonald, Ph.D., Professor of Biochemistry
Hagstrom, Earl C., Ph.D., Associate Professor of Psychology
Harris, Larry G., Ph.D., Assistant Professor of Zoology
Herbst, Edward J., Ph.D., Chairman and Professor of Biochemistry
Ikawa, Miyoshi, Ph.D., Professor of Biochemistry
Jones, Galen, E., Ph.D., Professor of Microbiology
Klippenstein, Gerald L., Ph.D., Assistant Professor of Biochemistry
Mathieson, Arthur C., Ph.D., Director of Jackson Estuarine Laboratory and Associate Professor of Botany
Metcalf, Theodore G., Ph.D., Professor of Microbiology
Milne, Lorus J., Professor of Zoology
Mulligan, Hugh F., Ph.D., Associate Professor of Botany
Sasner, John J., Ph.D., Associate Professor of Zoology
Sawyer, Philip J., Ph.D., Chairman and Professor of Zoology
Slanetz, Lawrence W., Ph.D., Director of Health Studies and Professor of Microbiology
Swan, Emery F., Ph.D., Professor of Zoology
Tillinghast, Edward, Ph.D., Assistant Professor of Zoology
Wheeler, Ellsworth H., Jr., Ph.D., Assistant Professor of Zoology

PHYSICAL SCIENCE

Anderson, Franz E., Ph.D., Associate Professor of Geology
Birch, Francis S., Ph.D., Assistant Professor of Earth Sciences
Bothner, Wallace A., Ph.D., Assistant Professor of Geology
Clark, David G., Ph.D., Associate Professor of Physics
Gaudette, Henri E., Ph.D., Associate Professor of Geology
Hall, Harry H., Ph.D., Professor of Physics
Loder, Theodore C., Ph.D., Assistant Professor of Earth Sciences
Tischler, Herbert, Ph.D., Chairman and Professor of Geology
Wilson, John A., Ph.D., Assistant Professor of Mechanical Engineering

SOCIAL SCIENCES

Andrews, Richard A., Ph.D., Associate Professor of Resource Economics
Barlow, Robert F., Ph.D., Professor of Economics and Administration
Durgin, Owen B., M.S., Associate Professor of Resource Economics
Henry, William F., M.S., Professor of Resource Economics

PHYSICAL EDUCATION

Waterfield, Allan D., M.S., Assistant Professor of Physical Education

Ocean engineering at the University of New Hampshire is centered in the Engineering Design and Analysis Laboratory (EDAL). EDAL has committed itself to the task of providing a real-world view of engineering by offering a variety of interdisciplinary, project-oriented academic experiences to undergraduate and graduate engineering students.

The following degrees are offered:
Department of Chemical Engineering: B.S., M.S.
Department of Civil Engineering: B.S., M.S.
Department of Electrical Engineering: B.S., M.S.
Department of Mechanical Engineering: B.S., M.S.

An interdepartmental engineering Ph.D. program is offered. A candidate may choose one of the following options: engineering systems design, signal processing, theoretical and applied mechanics or transport phenomena. These options offer opportunities for advanced study in ocean engineering.

An ocean engineering minor program is available to undergraduates. The program curriculum includes such courses as Introduction to Oceanography, Introduction to Ocean Technology, Physical Oceanography, Geological Oceanography, Naval Architecture in Ocean Engineering, Submersible Vehicle Systems Design, Underwater Acoustics, Coastal Engineering and Processes, and an Undergraduate Ocean Projects Course. Additionally, undergraduates who wish to become more deeply involved in ocean engineering activities may do so by associating themselves with professors and graduate students who are engaged in ocean projects.

The following courses are offered in conjunction with the above programs:

ELECTRICAL

785	Underwater Acoustics	4

MECHANICAL

737	Ocean Mechanics I	4
738	Ocean Mechanics II	4
751	Naval Architecture	4
752	Submersible Vehicle Systems Design	4
757	Coastal Engineering and Processes	4
808	Theoretical Aero/Hydro-Mechanics in Ocean Engineering	4
838	Theoretical Acoustics	4

ELECTRICAL-MECHANICAL

695	Engineering Projects	2-4
696	Engineering Projects	2-4

TECHNOLOGY

610	Introduction to Ocean Technology	4

CHEMICAL, CIVIL, ELECTRICAL, MECHANICAL

895	Master's Project, Problem or Independent Study	1-4
899	Master's Thesis	1-6

The instructional staff for the courses listed above consists of the following:

Allmendinger, E. Eugene, M.S., Associate Professor of Naval Architecture
Azzi, Victor D., Ph.D., Professor of Mechanics
Blanchard, Fletcher A., Jr., M.S., Professor of Electrical Engineering
Celikkol, Barbaros, Ph.D., Visiting Assistant Professor of Mechanical Engineering
Corell, Robert W., Ph.D., Professor of Mechanical Engineering
Fan, Stephen S., Ph.D., Associate Professor of Chemical Engineering
Gerhard, Glen C., Ph.D., Associate Professor of Electrical Engineering
Glanz, Filson, Ph.D., Associate Professor of Electrical Engineering
Limbert, David E., Ph.D., Assistant Professor of Mechanical Engineering
Melvin, Donald W., Ph.D., Associate Professor of Electrical Engineering
Murdock, Joseph B., Ph.D., Chairman and Professor of Electrical Engineering
Newman, A. Kiefer, Ph.D., Assistant Professor of Electrical Engineering
Nielsen, John P., Ph.D., Associate Professor of Civil Engineering
Pokoski, John, Ph.D., Associate Professor of Electrical Engineering
Savage, Godfrey H., Ph.D., Engineer, Director of EDAL and Professor of Mechanical Engineering
Sivaprasad, Kondagunta, Ph.D., Assistant Professor of Electrical Engineering
Skutt, H. Richard, Ph.D., Professor of Electrical Engineering
Stolworthy, E. Howard, B.S., Professor of Mechanical Engineering
Taft, Charles K., Ph.D., Professor of Mechanical Engineering
Torrest, Robert S., Ph.D., Assistant Professor of Chemical Engineering
Wilson, John A., Ph.D., Assistant Professor of Mechanical Engineering
Winn, Alden L., M.S., Professor of Electrical Engineering
Yildiz, Asim, D.Eng., Professor of Mechanics

To obtain further information, address all inquiries directly to:

Office of Marine Science and Technology
Kingsbury Hall
University of New Hampshire
Durham, New Hampshire 03824
(603) 862-1383

NEW YORK OCEAN SCIENCE LABORATORY
Montauk, New York 11954

The New York Ocean Science Laboratory (NYOSL), a center for integrated programs of research and development in the marine sciences, was founded by its present director, Dr. John C. Baiardi. The laboratory is operated under the auspices of a consortium of eight metropolitan colleges and universities known as Affiliated Colleges and Universities, Inc.

Although NYOSL does not offer formal academic courses nor awards degrees, it provides opportunity for sponsored thesis research at the laboratory which is applicable toward a degree at the member institutions, where M.S. and Ph.D. programs are offered. A special program of academic offerings is currently under review for inauguration in the near future.

The member institutions of the consortium include: Adelphi University, Fordham University, Hofstra University, Long Island University, New York University, St. John's University, New York Institute of Technology and State University of New York.

Located on 36 acres at Fort Pond Bay, Montauk, New York, the site and accommodations of the various buildings, with more than 300,000 square feet of available floor space, make them well suited for an oceanology complex. An 850-foot, L-shaped pier, five railroad sidings, a seaplane hanger and a helicopter pad are available. More than 50,000 square feet of available space have been converted into ocean sciences and research laboratories.

The laboratory has this past year installed an RCA electron microscope and has completed a running seawater laboratory which is occupied by fisheries and invertebrate biology scientists. A weather station, located on the premises, measures wind speed, barometric pressure, temperature-humidity and solar radiation. The NYOSL library has more than 2,000 titles and is a resource facility for information on the waters contiguous to Long Island.

Individual laboratories engaged in marine research projects at the present time include: biology, bioassay, biochemistry, biomedicine, chemical oceanography, fisheries oceanography, hydrologic engineering, microbiology (phytoplankton), microbiology (bacterial), phycology, physical oceanography, sanitary engineering and water quality.

Among the vessels used by the laboratory is the RV/Kyma, a 100-ton former U.S. army "T" boat converted for coastal and estuarine oceanographic research. Also, there are four Boston Whalers, one of which has electronic equipment which records various parameters, and a 22-foot rescue vessel equipped with a 500-horsepower inboard/outboard motor.

Laboratory staff involved in various research projects are:

John C. Baiardi, Ph.D., Director

Senior Research Scientists:

James E. Alexander, Ph.D., Chemical Oceanography
James P. Hunt, B.M.E., Marine Engineering Research
Eugene Premuzic, Ph.D., Biochemistry
R. H. White, B.S.C.E., Sanitary Engineering and Water Quality

Research Scientists:

Anthony D'Agostino, Ph.D., Marine Biology
Rudolph Hollman, Ph.D., Physical Oceanography

Associate Research Scientists:

Herbert M. Austin, Ph.D., Fisheries Oceanography
Josephine Hurst, Ph.D., Marine Biomedicine
Eugene Iannotti, Ph.D., Microbiology (Baeterial)
Robert Nuzzi, Ph.D., Microbiology (Phytoplankton)
Thore Omholt, Ph.D., Marine Engineering
John P. Wourms, Ph.D., Biology - Electron Microscopy

Mrs. Georgeanne O'Riordan, M.A., Librarian

Research Associates

Nicholas K. Coch, Ph. D., Marine Geology
Associate Professor
Dept. of Earth & Environmental Sciences
Queens College

Edward I Coher, Ph. D. (Parasitology)
Associate Professor of Biology
Southampton College

Peter P. Faiella, M.S. (Education)
Principal, John J. Daly Elementary School
Port Washington

Steven M. Hahn, M.S. (Electronics)
President
Detectron Security Systems, Inc.

Malcolm E. Hair, Ph. D. (Marine Ecology)
Assistant Professor of Biology
Adelphi University

Daniel M. Lilly, Ph. D. (Marine Protozoology)
Professor of Biology
St. John's University

Henry M. Moeller, Ph. D. (Phycology)
Coordinator, Marine Science Dept.
Dowling College

George D. Ruggieri, Ph. D. (Marine Biomedicine)
Director
Osborn Laboratories of Marine Sciences
New York Aquarium

Harold F. Udell, M.S. C. E. (Sanitary Engineering)
Director
Dept. of Conservation & Waterways
Town of Hempstead

To obtain further information, address all inquiries directly to:

Dr. John C. Baiardi, President-Director
New York Ocean Science Laboratory
Drawer EE
Montauk, New York 11954
Tele: (516) 668-5800

STATE UNIVERSITY AGRICULTURAL & TECHNICAL COLLEGE
Farmingdale, New York 11735

The two-year Biological Technology Curriculum at the State University at Farmingdale offers a second year major option in oceanology.

The teaching facilities consist of seven well equipped laboratories; one specially equipped to teach marine science, the others for supporting biological science courses. Additional facilities are a large walk-in cold room and the use of the Black Coral, a 68-foot research vessel fully equipped for marine research and teaching.

The following two-year college degree is offered: Associate in Applied Science (A. A. S.) in Biological Technology specializing in oceanology. The requirements are the successful completion of 65 credits including nine in social science, six in English, six in mathematics and 12 in chemistry.

The following undergraduate courses are offered in conjunction with the above program:

SC136	Botany	4
SC137	Zoology	4
SC104	General Microbiology	3
SC108	Entomology	3
SC105	Anatomy and Physiology	4
SC223	Principles of Ecology	3
SC134	Marine Botany	3
SC136	Marine Zoology	3
SC221	Introduction to Oceanography	3
SC203	Biological Instrumentation	2
SC204	Biochemistry	
--	Elective Scuba Diving course for certification	

The instruction staff for the listed courses:

Abbatiello, Michael, Ph. D., Professor
Alcamo, Edward, Ph. D., Associate Professor
Barke, Harvey, Ph. D., Professor
Elgart, Robert, M. S., Assistant Professor
Erlanger, Charles, M. S., Associate Professor
Pyenson, Louis, Ph. D., Professor and Chairman
Reicherter, Joel, M. S., Assistant Professor
Smiles, Michael, M. S., Instructor

To obtain further information address inquiries to:

Dr. Louis Pyenson, Chairman
Department of Biological Sciences
State University, Agricultural & Technical College
Farmingdale, New York 11735

THE MARITIME COLLEGE OF THE STATE UNIVERSITY OF NEW YORK
Fort Schuyler, Bronx, New York 10465

Marine Transportation (BS) Program. The students who successfully complete the courses offered in the marine transportation program receive the degree of Bachelor of Science and, after passing the required U. S. Coast Guard examinations, a federal license as third mate in the merchant marine. Registered as a general-purpose degree, the B. S. degree in marine transportation satisfies all the requirements of the Court of Appeals for admission to law schools in New York state.

The marine transportation curriculum provides a choice of transportation economics or transportation management. These consist of courses in nautical science, marine navigation, ocean transportation, maritime law, accounting, management, statistics and economics principles, geography, and international trade and labor. Theory and practice are integrated by relating the efforts of the academic year ashore to those of the Summer Sea Term (SST) aboard the college training ship during the summer.

The Summer Sea Term is made up of two sessions, each approximately six weeks long. Every third (sophomore) and second (junior) classman is required to take one of the two sessions each summer. The first (senior) classmen are required to take both sessions of the SST. The summer voyages are required, credit-bearing, staff-supervised educational periods intended to insure necessary operational experience for all cadets. The term begins about June 1 and ends about September 1.

The objectives of the SST are accomplished by on-the-job training, by actual watch standing and ship work, and instruction through formal class periods which are designed to enhance the professional knowledge of the students.

Transportation Management (MS) Program. In its master of science program, the Department of Marine Transportation of the Maritime College provides gradu-

ate-level education in the field of transportation management by: developing in the student a pattern of original and creative thought; developing skill in analyzing and solving problems, and identifying the vital issues confronting the maritime industry.

The program will be for part-time, primarily evening students. The general requirements for the degree are as follows: a minimum of 33 credits of appropriate graduate study; a minimum cumulative average of 3.0 in all courses accepted toward the degree; residence equivalent to one year (completion of 24 credits of part-time study); research and thesis, and passing a comprehensive examination.

A maximum of nine core credits can be applied to fulfill the minimum of 33 credits needed for the master's degree.

1501	Intensive Accounting	3
2501	Economic Analysis	3
2301	Business Management	3
2407	Marketing	3
2409	Finance: Money and Capital Markets	3
3502	Managerial Statistics I	3
4501	Intensive Survey of Business Law	3

In addition to the core requirements, the program will include all courses listed below not previously completed. A student must supplement the specialization requirements by taking sufficient electives to complete the total of 33 credits required for the degree.

2504	Industrial Relations in Transportation	3
3503	Managerial Statistics II	3
3506	Management of International Trade	3
3507	Introduction to Systems Analysis and Operations Research	3
3501	Analysis of Ocean or Air Transportation	3
2507	Economics of International Trade	3
3601	Thesis Seminar I	1
3602	Thesis Seminar II	2

Electives: The courses listed are illustrations of the range of offerings. Those offered in any term depend upon potential enrollment.

1502	Cost Accounting for Management	3
1503	Steamship Managerial Accounting	3
2502	Transportation Geography	3
2503	Latin American Business	3
2505	Financial Analysis	3
2506	Managerial Economics	3
3504	Ocean Marine Cargo and Hull Insurance	3
3505	Ocean Marine Insurance Loss Adjusting	3
3512	Governmental Regulation of Water Transportation	3
3590	Advanced Chartering Problems	3
3510	Tanker Management and Operation	3
3511	Marine Ports and Port Facilities	3
3513	Comparative Transportation Systems	3
3514	Behavioral Science	
3603	Seminar in Maritime Management Problems	3
3604	Seminar in Advanced Materials Handling	3
4502	Intensive Survey of Admiralty Law	3
5501	Data Processing Systems	3

The instructional staff for the courses listed above consists of the following:

MARINE TRANSPORTATION DEPARTMENT

Arthur, Carol, Ph.D., Assistant Professor of Economics
De Simone, Guy J., Master Mariner, M.B.A., Professor of Marine Transportation
Dutcher, Lester A., Master Mariner, M.B.A., Chairman and Professor of Transportation
Hart, John C., J.D., Lecturer in Admiralty Law
McAvoy, Eugene F., Chief Mate, B.S.
Millington, Herbert, Ph.D., Professor of Economics
Mueller, Frank W., M.S.E.E., Instructor of Marine Electronics
Parnham, Harold A., Master Mariner, M.A., Associate Professor of Marine Transportation
Ragonese, Frank F., Master Mariner, M.B.A., Instructor of Marine Transportation
Sembler, William, Master Mariner, M.B.A., Professor of Marine Transportation
Smukler, Philip R., M.A., Assistant Professor of Economics
Van Wart, Donald W., Chief Mate, M.B.A., Associate Professor of Marine Transportation

The Ocean Engineering Department is located in the Science and Engineering Building. The department offers the following four curricula, each of which earns a Bachelor of Engineering degree: marine engineering, electrical engineering, naval architecture, or an approved composite of the above.

All are registered for professional engineering purposes by the New York State Department of Education's State Board of Engineering and Land Surveying. This permits senior engineering students to sit before graduation for the first two parts of the three-part national professional engineer license examination.

The engineering student takes a common core of pre-engineering subjects for the first two years at the college. During the spring term of the sophomore year, the student elects to concentrate.

Facilities available include: the analog computer laboratory, equipped with fully expanded Electronics Associates Inc. computers, one 580 and three TR 20, each with X-Y plotter, digital voltmeter and associate equipment; the Electrical Circuits, Machinery and Electronics Laboratory; the Transport Processes Laboratory, a thermal, heat transfer and fluid mechanics facility with supersonic and subsonic equipment; the Mechanical-Marine Engineering Laboratory, with an instrumented turbine power plant, diesel and gasoline engines, gas turbine, fuel cell, air conditioning and refrigeration, and air compressor; the Systems and Controls Laboratory, with an Autodynamics, Inc. model 500 control systems trainer as well as five test stations; the Manufacture Processes Laboratory has lathes, milling machines, shapers, drill presses, welding booth facilities, metalizing and heat-treating equipment; the Strength of Materials Laboratory has extensive testing equipment, including a 200,000-pound universal testing machine, three 60,000-pound universal testing machines, two 10,000-pound torsion machines, a Warner-Swasey vibration fatigue machine, and an elevated temperature tension testing machine; the Design and Graphics Laboratory, and the digital computer-assisted laboratory is tied into an IBM 360 facility.

The afloat engineering laboratory is in the engineering spaces of the 8,500-horsepower converted college training vessel that is berthed during the academic year alongside the college's 600-foot pier. The ship's propulsion power plant is extensively instrumented with equipment including a shaft torsionmeter, laboratory-type pressure and temperature sensing devices, and 14 flowmeters that measure steam, water, gases, fuel oil and air.

The following courses are offered in the Ocean Engineering Department in conjunction with the above programs:

ELECTRICAL ENGINEERING

E 381	Electrical Engineering I	4
E 383	Network Analysis I	4
E 384	Electromagnetic Field I (Statics)	3
E 391	Electrical Engineering II	4
E 393	Networks Analysis II	3
E 491	Communications Theory	3
E 492	Switching Circuits	4
E 494	Power Systems (Optional Offering)	3
E 495	Electrical Machinery	4
E 496	Electron Devices	4

MARINE ENGINEERING

E 141	Orientation	3
E 241	Solid Mechanics I	4
E 251	Solid Mechanics II	3
E 251L	Solid Mechanics Laboratory	1
E 252	Transport Processes I	4
E 342	Transport Processes II	4
E 343	Engineering Analysis I	3
E 352	Transport Processes III	4
E 353	Engineering Analysis II	3
E 412	Ocean Engineering	4
E 441	Design I	4
E 442	Engineering Economics	2
E 451	Design II	4
E 452	Controls	3
E 453	Nuclear and Modern Concepts	2
E 454	Vibrations (Optional Offering)	3
E 454L	Vibrations Laboratory (Optional Offering)	1
E 459	Gas Dynamics (Optional Offering)	3

NAVAL ARCHITECTURE

NA 301	Ship Construction and Stability (for non-engineers)	3
E 361	Naval Architecture	4
E 362	Ship Form and Graphics	4
E 363	Ship Statics	3
E 461	Ship Design I	4
E 462	Ship Resistanee and Propulsion	3
E 463	Ship Structures	4
E 471	Ship Design II	4
E 472	Propeller Design (Optional Offering)	2
E 473	Ship Dynamics	3
E 478	Submersible Vehicles (Optional Offering)	3
E 479	Offshore Engineering Structures (Optional Offering)	3

OPERATIONAL COURSES

E 502	Summer Sea Term I - Operations I	3
E 503	Manufacturing Processes I	1
E 504	Manufacturing Processes II	1
E 507	Summer Sea Term II - Operations II	4
E 511	Summer Sea Term III - Operations III	5
E 512	Summer Sea Term III - Seminar	3
E 513	Ship Systems I	2
E 514	Ship Systems II	4
E 515	Ship Systems III	3

The teaching staff of the Ocean Engineering Department consists of the following:

Chu, Fen-Dow, M., N.A. and M.E., Assistant Professor
DiNatale, Pasquale, Machinist
Femenia, Jose, M.M.E., Assistant Professor
Fiandaca, Alphonse, Technical Specialist
Foody, John J., P.E., M.M.E., J.D., Professor and Chairman of Engineering
Gleicher, Norman, Ph.D., Associate Professor
Hoetzl, Charles, B.E., Technical Specialist and Training Ship Watch Officer
Kramer, Aaron R., P.E., M.M.E., Professor
Mathieson, John J., M.M.E., Associate Professor
McNeil, Joseph G., Ed.D., Professor
Pergament, Stuart P., Ph.D., Assistant Professor
Pfleging, Edward F., B.S., C.E., Professor
Rone, Edward C., Technical Specialist
Wennagel, Norman G., P.E., M.M.E., Professor
Youngren, Conrad, B.S., Technical Specialist and Training Ship Watch Officer
Zubaly, Robert B., I.E., M.S.M.E., Professor

To obtain further information, address all inquiries directly to:

Professor Lester A. Dutcher, Chairman
Department of Marine Transportation
State University of New York Maritime College
Fort Schuyler, Bronx, New York 10465

STATE UNIVERSITY OF NEW YORK AT STONY BROOK
Stony Brook, New York

On campus marine science laboratories are housed in a lab-office building with 14 research and teaching laboratories and others in an adjacent Biological Sciences building. Flax Pond, a 160-acre salt water marsh four miles north of the campus, is maintained as a teaching and instructional preserve by the State University of New York and the State Environmental Conservation Department. The Discovery Bay Marine Biology Laboratory, Jamaica, West Indies, was completed in 1970 and is jointly operated by the University of the West Indies and the State University of New York. State University, through the Marine Sciences Research Center at Stony Brook, is participating with Cornell in the development of the marine station on the Isles of Shoals off the coast of New Hampshire. The Marine Sciences Research Center operates the 40-foot R/V Micmac and a number of smaller boats for work in local waters.

Degree programs in the marine sciences are offered at the graduate level on the Stony Brook campus of the State University of New York. These include a terminal M.S. program in marine environmental studies aimed at preparing professionals in the field of marine environmental management and an M.A./Ph.D. program in marine biology.

1. M.S. in Marine Environmental Studies (Joint faculties of the Marine Sciences Research Center and the Marine Environmental Studies Program). The program is designed to prepare students to collaborate in many disciplines toward the solution of marine environmental problems. Formal instruction consists of a thoroughly interdisciplinary, problem-oriented curriculum offered by a closely interacting faculty representing many fields. To open the program to practicing professionals, the University residency requirement has been waived and students may also enroll on a part-time basis. All students must complete an approved course of study, normally 30 credits or more and including courses MAR 501, 502, 521, 522 and 580. As a requirement for the degree, students are expected to participate in a research program and submit a research paper dealing with a problem of the marine environment.

2. M.A./Ph.D. in Marine Biology (Jointly sponsored by the Biological Sciences Division and the Marine Sciences Research Center - Marine Environmental Studies Program). Requirements for the Ph.D. degree in marine biology are: (1) two years in residence as a full-time graduate student; (2) completion of an approved course of study, normally four semesters of course work; (3) a reading knowledge of one foreign language; (4) competence in computer languages and programming; (5) successfully sustain the preliminary examination, normally following completion of a major portion of the course work; (6) submission of an acceptable dissertation and an oral examination on the dissertation research and related areas.

Requirements for the master's degree in marine biology include one year of residence and requirements one through four of the doctoral program. A student may be permitted to substitute the submission and defense of a Master's dissertation for requirement four.

The following courses are offered in conjunction with the above programs:

GRADUATE COURSES

MARINE ENVIRONMENTAL STUDIES PROGRAM

MAR 501	The Marine Environment (Physical)
MAR 502	The Marine Environment (Biological)
MAR 511	Marine Instrumentation
MAR 512	Field Studies
MAR 521	General Problems of the Marine Environment
MAR 522	Case Studies
MAR 550	Topics in Marine Sciences
MAR 552	Topics in Marine Legal-Political Arrangements
MAR 553	Topics in Fisheries Ecology
MAR 580	Seminar
MAR 590	Research

MARINE BIOLOGY

REQUIRED COURSES

BIO 553	Biometry
MAR 501	The Marine Environment (Physical)
MAR 502	The Marine Environment (Biological)
MAR 551	Topics in Physical Oceanography
MAR 511	Marine Instrumentation
ESG 162	Computer Science

ELECTIVES

(students ordinarily take two or more)

BIO 334	Marine Vertebrate Zoology
BIO 338	Marine Planktonology
BIO 3[illegible]1	Microbiology
BIO [illegible]4	Biological Clocks
BIO [illegible]36	Physiology and Development of Lower Plants

OTHER COURSES SUITABLE FOR MARINE BIOLOGY

BIO 501	Biochemistry
BIO 503	Mechanisms of Enzyme Action
BIO 505	Microbial Regulatory Mechanisms
BIO 507	Chemistry and Enzymology of Nucleic Acids
BIO 509	Experimental Biochemistry I
BIO 510	Experimental Biochemistry II
BIO 512	Cellular Biology
BIO 513	Graduate Seminar in Molecular and Cellular Biology
BIO 514	Graduate Seminar in Molecular and Cellular Biology
BIO 515	Molecular and Cellular Biology Workshop
BIO 516	Molecular and Cellular Biology Workshop
BIO 520	Molecular Biology of Viruses
BIO 523	Topics in Animal Development
BIO 524	Cellular Aspects of Development
BIO 530	Projects in Developmental Biology
BIO 531	Graduate Seminar in Development Biology
BIO 532	Graduate Seminar in Development Biology
BIO 543	Topics in Animal Behavior and Physiology
BIO 544	Laboratory in Neurophysiology
BIO 550	Practicum in Ecology
BIO 551	Principles of Ecology
BIO 552	Multivariate Analysis in Biology
BIO 554	Population Genetics
BIO 570	Population and Community Ecology
BIO 575	Macromolecular Evolution
BIO 601	Colloquim in Molecular and Cellular Biology
BIO 602	Colloquim in Molecular and Cellular Biology
BIO 621	Developmental Biology Seminar
BIO 622	Developmental Biology Seminar
BIO 671	Seminar in Ecology and Evolution
BIO 672	Seminar in Ecology and Evolution

RELATED COURSES IN OTHER DEPARTMENTS

ESS 363	Sediments and Sedimentary Processes
ESS 364	Marine Geology
ESS 511	Advanced Paleontology
ESS 513	Micropaleontology
ESC 361	Applied Aero-and Hydromechanics

The instructional staff for the courses listed above consists of the following:

MARINE ENVIRONMENTAL STUDIES PROGRAM

Ali, Syed, Ph. D., Visiting Lecturer of Geology
Baylor, Edward, Ph. D., Professor of Biological Sciences
Bowman, Malcolm, Ph. D., Assistant Professor of Oceanography
Duedall, Iver, Ph. D., Assistant Professor of Chemical Oceanography
Gross, M. Grant, Ph. D., Professor of Oceanography
Hardy, C. Douglas, M. S. Lecturer
McHugh, John L. Ph. D., Professor of Marine Resources
Miller, H. Crane, LL. B., Visiting Professor of Law
Squires, Donald F., Ph. D., Professor of Biological Sciences and Earth and Space Sciences
Terry, Orville, Ph. D., Research Biologist
Weyl, Peter K., Ph. D., Professor of Oceanography
Williams, George C., Ph. D., Professor of Biological Sciences
Wurster, Charles F., Ph. D., Associate Professor of Environmental Sciences

DEPARTMENT OF BIOLOGY

Battley, Edwin J., Ph. D., Associate Professor of Biological Sciences
Carlson, Albert D., Ph. D., Associate Professor of Biological Sciences
Edmunds, Leland, Ph. D., Associate Professor of Biological Sciences
Gaudet, John T., Ph. D., Assistant Professor of Biological Sciences
Hechtel, George T., Ph. D., Assistant Professor of Biological Sciences
Jones, Raymond F., Ph. D., Professor of Biological Sciences
Lyman, Harvard, Ph. D., Associate Professor of Biological Sciences
Rohlf, F. James, Ph. D., Associate Professor of Biological Sciences
Slobodkin, Lawrence B., Ph. D., Professor of Biological Sciences
Tunik, Bernard D., Ph. D., Associate Professor of Biological Sciences
Walcott, Charles, Ph. D., Associate Professor of Biological Sciences

To obtain further information, address all inquiries directly to:

Marine Environmental Studies Program
Dr. Charles F. Wurster
Director of Graduate Studies
Marine Sciences Research Center
State University of New York
Stony Brook, New York 11790

Marine Biology
Dr. George Hechtel
Marine Biology Program
Division of Biological Sciences
State University of New York
Stony Brook, New York 11790

UNIVERSITY OF NORTH CAROLINA
Chapel Hill, North Carolina 27514

The University of North Carolina at Chapel Hill (UNC-CH) and North Carolina State University at Raleigh (NSCU-R) cooperate to offer a curriculum in marine sciences that involves several departments at each university. This description includes only the facilities and faculty at UNC-CH.

The University of North Carolina has teaching and research facilities on the campus at Chapel Hill, at the Institute of Marine Sciences at Morehead City, and at the Wrightsville Marine Biomedical Laboratory, Wilmington. Courses are taught on campus in several departments and research projects are also conducted in departmental laboratories. Special research facilities on campus include biological incubators; electron microscopes; gas chromatographs; infra-red spectrometer; gamma spectrometer; mass spectrometer; liquid scintillation counters, and computer center. The principal research facility is the Institute of Marine Sciences. A new laboratory building providing 20,000 square feet of space was completed on the shore of Bogue Sound in 1968. The R/V Machapunga, a 48-foot diesel-powered vessel specially built for estuarine research, is equipped with radio-telephone, fathometer, generators for 100 volt a. c. and 32 volt d. c., and a hydraulic winch for handling gear; it has a 600-mile cruising range and living accommodations for four persons. Several outboard-powered small boats are available.

Additional facilities at this coastal laboratory include a library, research collections of fishes, decapod crustaceans, and mollusks photographic darkroom, radio-isotope facilities, a large pier, a running saltwater system in a separate wing of the laboratory, large outdoor seawater tanks, and experimental seawater ponds. Research equipment includes microscopes, in situ salinometers, sampling bottles, nets and trawls, pyreheliometers, submarine photometer, oxygen and carbon dioxide analyzers, histological equipment, gas chromatograph, spectrophotometers, and many other types of general laboratory equipment.

Special equipment at Wrightsville Marine Biomedical Laboratory include pressure chambers to simulate terrestrial environments from +30,000 to -6,000 feet above sea level, together with apparatus and instrumentation for physiological and neurological studies; special problems in physical chemistry and strength of materials can also be undertaken.

The following degrees are offered:

1. Ph. D. in Marine Sciences (curriculum in Marine Sciences). For the Ph. D. degree each student will ordinarily take at least four of the following courses: Oceanography, Physical Oceanography, Geological Oceanography, Biological Oceanography and Chemical Oceanography, although his committee may approve other courses as satisfactory substitutes. He must also take Seminar in Marine Sciences at least twice and will study or do research at a marine laboratory or on an oceanographic cruise in a program approved by his committee. The dissertation will be on a marine topic. A minor is optional. A reading knowledge of two foreign languages is required; in some cases a research skill such as mathematics, statistics, or information science may be substituted for one language. Every student must gain some teaching experience during his program.

2. M. S. in Marine Sciences (curriculum in Marine Sciences). For the M. S. degree each student must earn at least 30 semester hours of credit, including at least three of the courses listed above for the Ph. D. degree or substitute courses that are satisfactory to his committee. He must take Seminar in Marine Sciences at least once, and a period of residence at a marine station or on an oceanographic cruise will ordinarily be required. A thesis on a marine topic is required. A minor is optional. A reading knowledge of one foreign language is required. Every student must gain some teaching experience during his program.

The following courses are offered in conjunction with the above programs:

GRADUATE

CURRICULUM IN MARINE SCIENCES

101	Oceanography	3
103	Geological Oceanography	4
104s	Biological Oceanography	6
105	Chemical Oceanography	3
105L	Chemical Oceanography Laboratory	1
120	Foundations of Geophysics	3
122	Physical Oceanography	3
141s	Special Problems in Marine Biology	6
161s	Problems in Marine and Environmental Physiology	2
206	Seminar in Oceanography	1
222	Advanced Physical Oceanography	3
226	Physical Oceanography Seminar	2
239	Micropalcontology--Foraminifera	4
268	Marine Geophysics	4
300	Research in Marine Sciences	2-up
393	Master's Thesis	3-up
394	Doctoral Dissertation	3-up

DEPARTMENT OF BOTANY

215	Marine Mycology	6
217	Algae II (Marine Algae)	5
219	Algal Physiology	5

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

122	Water Chemistry	4
132	Limnology and Water Pollution	3
134	Environmental Microbiology	3
233	Microbial Ecology	4
235	Ecology of Phytoplankton	4

DEPARTMENT OF GEOLOGY

117	Clay Mineralogy	4
161	Applied Geophysics	4
162	Applied Geophysics	4
165	Physics of the Earth	3
247	Sedimentation	4
248	Sedimentary Petrology	4

DEPARTMENT OF ZOOLOGY

109	Introduction to Hydrobiology	4
134	Invertebrate Development, Larvae, and Plankton	4
146	Marine Ecology	4
156	Advanced Marine Invertebrate Zoology	4
157	Advanced Marine Invertebrate Zoology	4
208A	Population Ecology	3
213	Advanced Marine Ecology	3
265	Seminar in Marine Biology	2

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BOTANY

Hommersand, Max H., Ph. D., Associate Professor

DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

Johnson, J. Donald, Ph. D., Professor of Environmental Chemistry

Kuenzler, Edward J., Professor of Environmental Biology

Lyman, John, Ph. D., Professor of Oceanography
Pfaender, Frederick K., Ph. D., Assistant Professor of Environmental Biology
Shuman, Mark S., Ph. D., Assistant Professor of Environmental Chemistry
Weiss, Charles M., Ph. D., Professor of Environmental Biology

DEPARTMENT OF GEOLOGY

Ingram, Roy L., Ph. D., Professor of Geology
Korgen, Benjamin J., Ph. D., Assistant Professor of Physical Oceanography
St. Jean, Joseph, Jr., Ph. D., Professor of Geology
Textoris, Daniel A., Ph. D., Associate Professor of Geology
Wheeler, Walter Hall, Ph. D., Professor of Geology

DEPARTMENT OF ZOOLOGY

Jenner, Charles E., Ph. D., Professor
Lehman, Harvey Eugene, Ph. D., Professor
McMahan, Elizabeth Anne, Ph. D., Professor
Rieger, Reinhard M., Ph. D., Assistant Professor

INSTITUTE OF MARINE SCIENCES

Chestnut, Alphonse F., Ph. D., Director of the Institute of Marine Sciences; Professor of Zoology
Fahy, William E., Ph. D., Professor of Zoology in the Institute of Marine Sciences
Neumann, A. Conrad, Ph. D., Professor of Marine Sciences
Schwartz, Frank J., Ph. D., Associate Professor in the Institute of Marine Sciences
Woods, William J., Ph. D., Associate Professor in the Institute of Marine Sciences; Associate Professor of Botany.

WRIGHTSVILLE MARINE BIOMEDICAL LABORATORY

Brauer, R. W., Ph. D., Director; Visiting Professor of Physiology

To obtain further information, address all inquiries directly to:

Dr. Edward J. Kuenzler, Chairman
Curriculum in Marine Sciences
University of North Carolina
Chapel Hill, North Carolina 27514

UNIVERSITY OF NORTH CAROLINA AT WILMINGTON
Wilmington, North Carolina 28401

Marine science activity at the University of North Carolina at Wilmington consists of instructional and research programs on the University's main campus, as well as specialized research activities associated with its institute for Marine Bio-Medical Research at Wrightsville Beach.

The program in marine sciences at the university's main campus is a three-faceted one consisting of a marine biology curriculum leading to the B.S. Degree, an environmental studies curriculum with an emphasis in marine science leading to the A. B. Degree, and a marine science research program including faculty members engaged in various aspects of marine science research.

The marine biology curriculum includes a basic introduction to the field of biology with an emphasis at the upper level in various aspects of marine biology. The program includes a team research project in marine ecology. The environmental studies curriculum is a multi-disciplinary one in which students may elect to emphasize marine science. This curriculum is designed to expose the student to a broad range of investigatory procedures in the natural and social sciences while allowing him to develop special capabilities in marine science.

The marine science research program currently has ten active participants with research interests covering several areas of marine biology, certain aspects of physical and chemical oceanography, marine geology and marine biogeography. There are two categories of participants in the program: those who hold research positions with minimal teaching responsibilities and those who hold regular teaching positions but who are also engaged in marine science research.

A building to house much of the university's marine science program is now under construction. Comprising approximately 50,000 square feet, the building will contain ample modern teaching and research facilities, and will complement the recently constructed Chemistry-Physics Building and the Institute for Marine Bio-Medical Research in the university's overall marine science effort.

Included in the curricula of the degree programs described above are the following marine science courses:

Geo 205	Introduction to Physical Oceanography	3
Bio 362	Marine Biology	4
Bio 365	Invertebrate Zoology	4
Bio 446	Marine Phycology	4
Bio 466	Marine Ecology	4
Bio 491	Directed Individual Study in Marine Biology	1-6
Geol 305	Marine Geology	4
Geo 432	Marine Biogeography	4
Geol 491	Directed Individual Study in Marine Geology	4
	Environmental Studies, particularly as related to the marine environment: 195, 295 and 395 are 1 credit for each course.	

Instructional staff for the courses listed above consists of the following:

Adcock, Louis H., Ph. D., Associate Professor of Chemistry
Cleary, William J., Ph. D., Assistant Professor of Geology
Dermid, Jack F., M.S., Assistant Professor of Biology
Hosier, Paul E., Ph. D., Assistant Professor of Biology
Kapraun, Donald F., Ph. D., Assistant Professor of Biology
Lundeen, Carl V., Ph. D., Assistant Professor of Biochemistry
McCrary, Anne B., Ph. D., Assistant Professor of Biology
Parnell, James F., Ph. D., Professor of Biology
Randall, Duncan P., Ph. D., Professor of Geography
Roye, David B., Ph.D., Assistant Professor of Biology
Thayer, Paul A., Ph. D., Assistant Professor of Geology
Zullo, Victor A., Ph. D., Professor of Geology

To obtain further information direct all inquiries to:

Dr. Daniel B. Plyler, Director
Program in Marine Sciences
University of North Carolina at Wilmington
Wilmington, North Carolina 28401

NORTH CAROLINA STATE UNIVERSITY
Raleigh, North Carolina 27607

Marine science courses and related studies are offered on the Raleigh campus and at the following off-campus facilities:

The Pamlico Marine Laboratory near Aurora, North Carolina offers research capabilities that encompass the effects of man's activities on the estuarine and marine environment. The physical facilities include three laboratory buildings, a dormitory, and various research vessels, the largest of which is a 35-foot shrimp trawler. One building is furnished with two salt water flow-through systems for the maintenance and culture of estuarine organisms. Two large walk-in coolers are also available for temperature and photoperiod control. Six one-half acre ponds have been constructed for experimental work. These ponds are designed to simulate natural estuaries but are subject to environmental control. A large series of smaller pools with flow-through control is also available. The Hatteras Marine Laboratory is located at the southern end of Hatteras Island, North Carolina. Both northern and southern faunas are found in adjacent waters. There is a main office laboratory building and a large dissecting room and facilities for maintaining live organisms. Research programs include population dynamics of marine fishes. Harbor House Marine Sciences Center is located on the intercoastal waterway between Wilmington and Wrightsville Beach, North Carolina. This facility serves as an extension center for marine sciences but has the capability for providing space for small laboratory requirements and living accommodations for visiting researchers. A 24-foot inboard boat is available for survey or sampling work. Through cooperative arrangements, the facilities at Duke University's Marine Laboratory at Beaufort, North Carolina, and the University of North Carolina's Institute of Marine Sciences at Morehead City, North Carolina, are available for research purposes. Arrangements can also be made to utilize the R/V Advance II and Undaunted that are operated by the Cape Fear Technical Institute at Wilmington, North Carolina.

A Marine Science Center funded by the Coastal Plains Regional Commission and the State of North Carolina is presently under construction at three sites along the coast are near Manteo, North Carolina, near Morehead City, North Carolina, and near Wilmington, North Carolina. This center will provide for public and secondary school education in the Marine Sciences, for advisory services to marine-related industries and for marine-related research. The marine-related research will be carried out primarily by research faculty from the campuses of the universities in North Carolina. Each building will be approximately 30,000 sq. ft. with about one-fourth of this space devoted to research activity.

The university offers both the Ph. D. and M. S. in marine sciences through cooperating departments. The Center for Marine and Coastal Studies acts in a coordinating capacity to bring together the marine sciences faculty and provide the leadership for the graduate program. The requirements for the major for the Ph. D. degree are determined by the student's advisory committee. Normally, these will include four of five core courses (general, physical, biological and chemical oceanology and marine geology). Other courses will be selected from the general listing of courses in areas related to marine science. A doctoral candidate will be expected to take the marine sciences seminar at least twice during his period of study. A period of residence at a marine station or on an oceanographic cruise in a program approved by the supervisory committee is required.

The M.S. program is essentially similar to the doctoral program except that only three of the five core courses and one semester of seminar are required. Normally, a period of residence at the marine station or on an oceanographic cruise in a program approved by the student's advisory committee will be required. A thesis in a marine science-related area is required.

During the 1971-1972 academic year, there were two Ph. D. graduates in physical oceanography. The following courses in marine sciences are offered primarily in four departments: botany, civil engineering, geosciences and zoology.

CORE COURSES

MAS	487	Physical Oceanography	3
MAS	529	Biological Oceanography	3
MAS	584	Marine Geology	3
MAS	591	Oceanology Seminar	1

ADDITIONAL COURSES

ZO	420	Fishery Science I	3
ZO	621	Fishery Science II	3
ZO	441	Ichthyology	3
BO-ZO	442	General Ecology	4
GY	486	Weather and Climate	2
ZO	515	Growth and Reproduction of Fishes	3
ZO	517	Population Ecology	3
ZO	519	Limnology	4
ZO	619	Advanced Limnology	3
BO	574	Phycology	3
MB	401	General Microbiology	4
ZO	350	Invertebrate Zoology	4
GY	452	Exogenic Materials and Processes	4
GY	552	Exploratory Geophysics	3
GY	563	Applied Sedimentology	3
GY	567	Geochemistry	3
SSC	553	Soil Mineralogy	3
MAS	581	Introduction to Oceanographic Engineering	3
MAS	471	Undersea Vehicle Design	3
CE	517	Water Transporation	3
CE	548	Engineering Properties of Soils	3
CE	549	Engineering Properties of Soils	3
CE	641	Advanced Soil Mechanics	3
CE	642	Advanced Soil Mechanics	3
EM	504	Mechanics of Ideal Fluids	3
EM	505	Mechanics of Viscous Fluids I	3
EM	612	Mechanics of Viscous Fluids II	3
MAE	651	Principles of Fluid Motion	3
MAE	431	Thermodynamics of Fluid Flow	3
MAS	541	Gravity Wave Theory	3
MAS	551	Ocean Circulation	3
MAS	581	Introduction to Oceanographic Engineering	3
MAS	601	Advanced Physical Oceanography I	3
MAS	602	Advanced Physical Oceanography II	3
MAS	605	Advanced Geophysical Fluid Mechanics I	3
MAS	606	Advanced Geophysical Fluid Mechanics II	3
MAS	613	Perturbation Methods in Fluid Mechanics I	3
MAS	614	Perturbation Methods in Fluid Mechanics II	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOCHEMISTRY

Longmuir, Ian S., M. B. B., Professor

DEPARTMENT OF BOTANY

Cooper, Arthur W., Ph. D., Professor

DEPARTMENT OF CIVIL ENGINEERING

Amein, Michael, Ph. D., Associate Professor
Langfelder, Jay, Ph. D., Associate Professor
Machemehl, Jerry L., Ph. D., Assistant Professor
Wahls, Harvey, E., Ph. D., Professor

DEPARTMENT OF ENGINEERING MECHANICS

Edwards, John A., Ph. D., Professor
Sorrell, Furman Y., Ph. D., Associate Professor

DEPARTMENT OF FOOD SCIENCE

Webb, Neil B., Ph. D., Associate Professor

DEPARTMENT OF GEOSCIENCES

Huang, Norden E., Ph. D., Assistant Professor
Knowles, Charles E., Ph. D., Assistant Professor
Leith, Carlton J., Ph. D., Professor and Head
Lyman, John, Ph. D., Professor
Saucier, Walter J., Ph. D., Professor of Meteorology and Geosciences
Smith, James R., M. S., Adjunct Assistant Professor of Oceanology
Welby, Charles W., Ph. D., Associate Professor.

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Royster, Larry H., Ph. D., Professor
Williams, James C., III, Ph. D., Professor

DEPARTMENT OF SOIL SCIENCE

Woodhouse, William W., Ph. D., Professor

DEPARTMENT OF ZOOLOGY

Copeland, B. J., Ph. D., Associate Professor
Hassler, William W., Ph. D., Professor
Hayne, Don W., Ph. D., Professor of Zoology and Experimental Statistics
Hobbie, John E., Ph. D., Associate Professor
Wolcott, Thomas, Ph. D., Associate Professor

NATIONAL MARINE FISHERIES LABORATORY

Ford, A. Cross, Ph. D., Adjunct Assistant Professor of Zoology
Huntsman, Gene R., Ph. D., Adjunct Assistant Professor of Zoology
Rice, Theodore R., Ph. D., Adjunct Assistant Professor of Zoology
Williams, Richard B., Ph. D., Adjunct Assistant Professor of Zoology
Wolfe, Douglas A., Ph. D., Adjunct Assistant Professor of Zoology

To obtain further information, address all inquiries directly to:

Jay Langfelder, Director
Center for Marine and Coastal Studies
North Carolina State University
1204 Burlington Labs
Raleigh, North Carolina 27607
(919) 737-3326

NORTHEASTERN ILLINOIS UNIVERSITY
Chicago, Illinois 60625

Northeastern Illinois University offers an interdisciplinary program in oceanography. The principal teaching and research center is located on the university campus approximately four miles from Lake Michigan. Because of the proximity, size and regional importance of the lake, a number of year-round projects are being pursued in this area. Facilities at the university include water and sediment sampling gear, underwater photography equipment, a complete sediment analysis lab (including x-ray fluorescence and x-ray diffraction), three large laboratory-lecture rooms, a photography lab, a weather facsimilie recorder and a seismology lab. In addition, the Department of Earth Sciences sponsors an Environmental Quality Institute which has available a water analysis lab (including an atomic absorption spectrophotometer). Coastal oceanography courses and research projects are run during the summer at field camps on Martha's Vineyard, Massachusetts; at the Station de Biologie Marine of the Universite de Bordeaux at Arcachone, France, and at the Pacific Marine Station of the University of the Pacific, Dallon Beach, California. The station in France has two small vessels at its disposal. The Pacific Marine Station has in addition to laboratory facilities a 42-foot research vessel, an 18-foot Boston Whaler in addition to smaller runabouts.

The university does not offer a program leading to the undergraduate or advanced degrees in the marine sciences. The undergraduate students interested in oceanography may follow a program leading to a B. A. degree in the earth sciences or geography, with a concentration in oceanography. Graduate students may obtain an M. A. in geography or earth sciences with a concentration in oceanography. The programs listed require thirty hours of course work in the major. Of this, a major portion may consist of oceanography or marine sciences courses.

1. B. S. in Earth Sciences. Three semester hours in each of the following areas: geology, meteorology, oceanography and one field course; 18 semester hours in earth science electives; and 15 hours in other natural science and mathematics.

2. B. S. in Earth Sciences--Secondary Education. Course requirements are 24 hours in earth science, nine hours of electives in earth science or geography, eight hours in chemistry and physics and four hours in materials and methods of teaching earth science.

3. M.S. in Earth Sciences. Thirty semester hours in graduate Earth Science courses and a total of at least 45 semester hours of combined graduate and undergraduate level earth science credit. A thesis is required.

4. B. A. in Geography. Nine semester hours in each of the following areas: physical geography, human geography and six hours in regional geography and six hours of geography electives. The electives and six of the nine hours of physical geography may be taken in marine science courses.

5. B. A. in Geography--Secondary Education. Six hours in each of physical, topical, regional geography and twelve hours of electives. The electives and three hours of physical geography may be taken in marine science courses.

6. M. A. in Geography. The requirements include 27 hours in geography and six for thesis. Three courses (three credits each) are required: cartography, statistics for earth sciences and geography, and scope and philosophy of the geographical sciences. The remaining 18 hours may be taken in marine science courses, and the program must be organized systematically under the guidance of the faculty advisor. The thesis should be written in an area of concentration. A final examination is administered by the faculty of the geography department

The following courses are offered in conjunction with the above programs. 100 or 200 level courses are designated "undergradutate", 300 or 400 level courses are designated "graduate".

43-343	Polar Geography	3
43-351	Statistics for Earth Science and Geography	3
43-352	Independent Study in Geography	3
43-373	Biological Geography (Oceanography)	3
43-442	Geographic Problems in Quantitative Measurements	3
43-421	Climatology	3
43-431	Thesis Seminar	3
43-441	Mathematical Geography	3
53-309	Geochemistry	3
53-273	Meteorology I	3
53-313	Meteorology II	3
53-317	Principles of Sedimentation	3
53-318	World Regional Geology	3
53-323	Field Geology	3
53-324	Oceanography I	3
53-325	Oceanography II	3
53-326	Individual Study in Earth Science	3
53-328	Marine Geology	3

53-205	Water Resources in Urban Environmeot	3
53-407	Hydrogeology	3
53-413	Atmospheric Science	3
53-414	Thesis Seminar: Earth Science	6
56-317	Ecology	3
56-373	Biological Geography	3
57-316	Algology	3
58-315	Invertebrate Zoology	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Betz, Robert F., Ph. D., Professor
Wiercinski, Floyd J., Ph. D., Professor

EARTH SCIENCE

Charlier, Roger, H., Ph. D., Professor
Forslev, Albert, Ph. D., Professor, Chairman
Doehler, Robert W., Ph. D., Associate Professor
Qutub, Musa Y., Ph. D., Associate Professor
Shabica, Charles W., Ph. D., Assistant Professor
Sood, Mohan K., Ph. D., Assistant Professor

GEOGRAPHY

Dierickx, C. Wallace, Ph. D., Professor, Chairman
Millard, William, Ph. D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Charles W. Shabica, Dept. of Earth Sciences
Northeastern Illinois University
Bryn Mawr at St. Louis Avenue
Chicago, Illinois 60625

OLD DOMINION UNIVERSITY
INSTITUTE OF OCEANOGRAPHY
Norfolk, Virginia 23508

The institute occupies a 20,000-sq.-ft. building on the campus of Old Dominion University with eight laboratories for biological, chemical, geological, and physical oceanography. It maintains docking facilities at the Naval Amphibious Base at Little Creek, Norfolk, Virginia. A 65-foot former Army T-boat has been converted by the institute for use in coastal and estuarine studies. The vessel contains oceanographic winches, sampling equipment, and laboratory facilities. Two smaller vessels are also operated by the institute. Investigators with research projects requiring larger vessels have access to nearby vessels. Research equipment includes inductive salinometers, deep-sea reversing thermometers, various water sampling bottles, various biological collection nets, transmissometers, current meters, wave and tide analyzer, gas chromatograph with dual helium ionization detectors and with dual flame ionization detectors including peak integration, atomic absorption spectrophotometer, gas partitioner, CO_2 analyzers, Beckman DU spectrophotometers with 10-centimeter attachment, portable nitrate to nitrite reduction system, portable modified winkler dissolved O_2 system, portable pH meter, high-speed continuous flow centrifuge, rapid sediment analyzer, ro-taps, various sediment sampling devices, microscopes, photographic equipment (both laboratory and underwater), and complete diving locker.

In order to qualify for a degree of Master of Science with a concentration in oceanography, a student must meet the following general requirements and either thesis or non-thesis option requirements:

1. He or she must have satisfied the various degree requirements established by the university and stated in the graduate catalogue.

2. He or she must complete the core program of 17 semester hours, listed below.*

3. a. For thesis option, he or she must complete nine semester hours at the 500 level, three semester hours of research, and three hours of thesis. The student must pass a final comprehensive examination which will be an oral and/or written examination on the thesis and closely related topics.

b. For non-thesis option, he or she must complete 15 semester hours at the 500 level, three semester hours of special topics, and three semester hours of research. The student must pass a final comprehensive examination which will be an oral and/or written examination.

Seven MS degrees were granted during 1972.

The following courses are offered by the institute in conjunction with the above program:

UNDERGRADUATE COURSES

106	Introductory Oceanography	3
107	Introductory Oceanography	3
406	Oceanography	3

GRADUATE COURSES

501	Oceanographic Analysis	3
504*	Physical Oceanography I	3
505*	Physical Oceanography II	3
506	Dynamical Oceanography	3
507	Waves and Tides	3
508	Underwater Sound	3
509	Optical Oceanography	3
510*	Chemical Oceanography	3
512	Advanced Chemical Oceanography	3
520*	Geological Oceanography	3
525	Dynamics of Marine Sedimentation	3
528	Marine Sediments	3
531	Marine Geophysics	3
532	Geochemistry of the Oceans	3
540*	Biological Oceanography	3
541	Marine Phycology	3
542	Marine Mycology and Microbiology	3
543	Physiology of Marine Plants	3
544	Physiology of Selected Marine Animals	3
560	Environmental Control in the Ocean	3
570	Estuarine Physical Processes and Modeling	3
591*	Seminar	1
592*	Seminar	1
595	Special Topics in Oceanography	3
598	Research	1-9
599	Thesis	1-9

*Core required courses.

Under special circumstances, elective courses available in other departments as listed below may be substituted for certain of the 500-level courses required under 3a or 3b above.

DEPARTMENT OF BIOLOGY

415	Marine Ecology	4
417	Limnology	4
419	Marine and Estuarine Plankton	4
420	Ichthyology	4

SCHOOL OF ENGINEERING

405	Topics in Engineering Mathematics	3
413	Hydraulics and Coastal Engineering	3
417	Water Resource Engineering	3
437	Aerodynamic Design	3
509	Special Topics (Applied Hydraulics)	3
509	Special Topics (Water Resources)	3
541	Advanced Classical Thermodynamics	3

545	Potential Flow Theory	3
546	Boundary Layer Theory	3
549	Advanced Fluid Dynamics	3

DEPARTMENT OF GEOPHYSICAL SCIENCES

416	Paleoecology	4
417	Geochemistry I	3
422	Phase Geochemistry	3
425	Coastal Plain Geology	3
432	Sedimentary Petrology	4
435	Micropaleontology	3

DEPARTMENT OF PHYSICS

561	Principles of Atmospheric Physics	3
564	Dynamic Meteorology	3
565	Physics of the Marine Atmosphere	3
566	Special Topics in Environmental and Space Physics	3

The instructional staff for the courses listed above consists of the following:

Adams, Donald D., M.Sc., Assistant Professor of Oceanography
Fleischer, Peter, Ph.D., Oscar F. Smith Assistant Professor of Oceanography.
Johnson, Ronald E., Ph.D., Assistant Professor of Oceanography
Ludwick, John D., Jr., Ph.D., Samuel L. and Fay M. Slover Professor of Oceanography and Director of the Institute of Oceanography and Graduate Program Director
Ofelt, George S., Ph.D., Associate Professor of Oceanography
Zaneveld, Jacques S., D.Sc., Samuel L. and Fay M. Slover Professor of Oceanography.

JOINT APPOINTMENTS:

Bandy, Alan R., Ph.D., Assistant Professor of Chemistry and Oceanography
Becher, Jacob, Ph.D., Assistant Professor of Physics and Oceanography
Birdsong, Ray S., Ph.D., Associate Professor of Biology and Oceanography
Gosink, Thomas A., Ph.D., Associate Professor of Chemistry and Oceanography
Harris, Franklin S., Jr., Ph.D., Senior Scientist in Chemistry and Oceanography
Kirk, Paul W., Jr., Ph.D., Associate Professor of Biology and Oceanography
Marshall, Harold G., Ph.D., Professor of Biology and Oceanography and Chairman of the Biology Department
Ousterhout, Don S., D.Sc., Professor of Engineering and Oceanography and Acting Dean of the School of Engineering
Shideler, Gerald L., Ph.D., Associate Professor of Geophysical Sciences and Oceanography
Spaulding, Malcolm L., Ph.D., Assistant Professor of Engineering Mechanics and Oceanography
Spencer, Randall S., Ph.D., Assistant Professor of Geophysical Sciences and Oceanography

ADJUNCT APPOINTMENT

Swift, Donald J.P., Ph.D., Adjunct Associate Professor of Oceanography

To obtain further information, address all inquiries directly to:

Dr. Charles E. Bell, Jr.
Dean of Graduate Studies
Old Dominion University
Norfolk, Virginia 23508
(703) 489-8000, ext. 316

ORANGE COAST COLLEGE
Costa Mesa, California

The campus is four miles from the ocean, some 40 miles southwest of Los Angeles. Marine science facilities at Orange Coast College include a 9,000-gallon closed refrigerated marine aquarium system; separate refrigerated aquaria; water-immersion microscopes and related optical equipment; access through remote terminals to an IBM 370 located on the campus for data processing; portable electronic calculators for field use; portable electronic sensing equipment for dissolved oxygen, temperature, salinity, pH, conductivity, etc.; biological sampling equipment such as bottom dredges, plankton nets and open water trawls; two 16-foot Boston Whalers for near-shore investigations, and two laboratories designated for marine courses on campus.

The A.A. degree in Marine Technology is offered. The two-year curriculum provide concentration in the biological and physical science areas. The program is not designed to prepare students for transfer to a four-year college. Coursework consists of marine science core courses, support courses in physics and mathematics, and general education courses required for the A.A. degree.

The following courses are offered in conjunction with the above program:

Mar Sc	100	The Marine Sciences	3
Mar Sc	185	Ocean Resources	3
Mar Sc	210	Seamanship & Navigation	3
Mar Sc	280	Marine Biology	3
Mar Sc	285	Oceanographic Technology	4
Math	045	Inter Tech Math	3
Elec T	170	Elect Const Tech	2
Ind Arts	140	Electronics	3
Env Sci	140	Chemistry	4
Env Sci	240	Water Analysis	3
BIS	114	Basic Programming	1
Phys	110	Intro Physics	3
Eng	105	Tech Report Writing	3
P.E.	110AD	Skindiving	1
P.E.	111AD	Scuba Diving	2
Geo	100	Intro Geology	3
Env Sci	100	Intro Ecology	3
Bio	100	Intro Biology	3
Ind Arts	150	Welding	3
Ind Arts	120	Drafting	2
Ind Arts	130	Machine Shop Pract.	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF MARINE TECHNOLOGY

Garrison, Tom S., M.A., Assistant Professor of Marine Biology, Coordinator
Reese, James I., M.S., Instructor in Marine Technology

To obtain further information, address all inquiries directly to:
Mr. Tom S. Garrison, Coordinator
Department of Marine Sciences
Orange Coast College
2701 Fairview Road
Costa Mesa, California 92626

UNIVERSITY OF OREGON
Eugene, Oregon 97403

The university offers marine biology courses at both its main campus in Eugene and at Oregon Institute of Marine Biology, Charleston, Oregon. A modern science building in Eugene includes laboratory facilities for departments of biology, chemistry, molecular biology and physics.

Oregon Institute of Marine Biology is located on about 85 acres along Coos Bay. The institute buildings include dormitories, dining hall, classrooms and laboratories. There are six laboratory classrooms with running salt water, study tables and benches. One renovated building, used for year-round research, houses modern equipment such as a refrigerated centrifuge, spectrophotometers, and scintillation systems, Zeiss microscope equipped with Nomarski optics.

No degrees are offered by the institute; however, the University of Oregon awards credit, including graduate credit for all courses designated (G) or at the 500 level. Work done at the institute may form an integral part of the work towards Bachelor's, Master's, or Ph. D. degrees in Biology offered on the Eugene campus.

Courses in the marine sciences are offered during the regular year at the main campus by the Department of Biology and Graduate School. The Department of Biology and the Graduate School also offer both regular summer and special workshop courses at the institute. Independent studies and research have been carried out on a year round basis at the institute since 1968. During the spring of 1973, a multi-disciplined approach to man and his environmental problems will be offered entitled Man and the Oregon Coast. This program will include courses in biology, sociology, geography, and landscape architecture.

The following courses are offered at the institute. All courses can be taken for undergraduate credit. Those marked with a (G) or at the 500 level will satisfy graduate requirements.

Bio	406	Environmental Projects (G)	4
Bio	413	Comparative Physiology (G)	12
Bio	458	Marine Birds and Mammals (G)	4
Bio	461	Invertebrate Zoology (G)	8
Bio	474	The Marine Environment (G)	8
Bio	478	Marine Ecology (G)	8
Bio	401	Research	
Bio	501	Research	
Bio	403	Thesis	
Bio	503	Thesis	
Bio	407	Seminar - Topics in Marine Biology	
Bio	507	Seminar - Topics in Marine Biology	
Bio	408	Laboratory Projects	
Geo	407	Coastal Problems	3
Geo	485	Cartography	3
Bio	478	Marine Ecology	3
407/507		Seminar in Planning & Landscape Architecture	
Soc	326	Quantitative Methods in Sociology	3
Soc	407/507	Seminar in Sociological Methods	3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Hartman, H. Bernard, Ph. D., Visiting Assistant Professor of Zoology
Mcconnaughey, Bayard H., Ph. D., Associate Professor of Biology.
McGowan, John A. Ph. D., Visiting Professor of Oceanography
Oglesby, Larry C., Ph. D., Visiting Professor of Zoology
Rudy, Paul P., Ph. D., Associate Professor of Biology, University of Oregon, Director, Oregon Institute of Marine Biology.
Terwilliger, Robert C., Ph. D., Assistant Professor of Biology, University of Oregon, Assistant Director, Oregon Institute of Marine Biology.

GEOGRAPHY -

Loy, William G., Ph. D., Assistant Professor

LANDSCAPE ARCHITECTURE

Diethelm, J. K., Ph. D., Professor

SOCIOLOGY

Faich, Ronald G., Ph. D., Assistant Professor

To Obtain further information, address all inquiries directly to:

Dr. Paul P. Rudy, Director
Oregon Institute of Marine Biology
Charleston, Oregon 97420

UNIVERSITY OF OREGON SCHOOL OF LAW
Eugene, Oregon 97403

The Law School offers courses at the legal center building on the campus in Eugene. An Ocean Law Library and the facilities of the Law School library are used for research. In conjunction with the marine advisory program, the Law School conducts seminars at the law center and at various coastal locations, attended by members of Oregon ocean industries, Oregon State University oceanographers, other scientists, Oregon Law School faculty members and interested members of the bar and government.

The Oregon Law School ocean law program is part of the Oregon State University Sea Grant College. The J.D. degree is offered.

The following courses are offered in conjunction with the above program:

Ocean Resources Law	3
International Law	3
Natural Resources Law	3
Environmental Quality	3
Water Law	3
Admiralty Law	3

The instructional staff for the courses listed above consists of the following:

Barry, Frank J., LL. B., Professor
Clark, Chapin D., LL.M., Professor
Jacobson, Jon L., J.D., Associate Professor
Swan, Peter N., LL. B., Associate Professor

To obtain further information, address all inquiries directly to:

Professor Jon L. Jacobson
University of Oregon School of Law
Eugene, Oregon 97403

OREGON STATE UNIVERSITY
Corvallis, Oregon 97331

On 1 July 1972, oceanography at Oregon State University was changed in status from department to school.

Course work is offered on the main campus in Corvallis where the School of Oceanography occupies two buildings. A four-story building with 30,000 square feet of research laboratory and office space was completed in 1964. About 29,000 square feet of additional research laboratory and office space was completed in 1970 through 1972. Adjacent temporary buildings are used for special projects and machine shops.

At Newport, the Marine Science Center, completed in 1965, is used by several departments at Oregon State University. It consists of three wings; one contains a public aquarium, museum and auditorium; another is used for fisheries and pollution research, and the third is used for basic research in oceanography and zoology.

Docking and support facilities for ocean research vessels and for small boats are adjacent to the Marine Science Center on Yaquina Bay. Two ocean-going research vessels are based in Newport. The 180-foot R/V Yaquina and the 80-foot R/V Cayuse are both equipped for all types of marine research. Yaquina, with eight laboratories and space for 18 scientists, is used primarily for deep ocean work and for long cruises. Cayuse has three laboratories and space for seven scientists. It is used mostly for work over the continental shelf and in inshore waters.

Smaller research craft include the 33-foot R/V Paiute (based in Newport) and the 37-foot R/V Sacajawea (based in Astoria, Oregon). Both of these vessels are used for estuarine and coastal research, along with other small craft with outboard motors.

The School of Oceanography offers the M.A., M.S., and Ph.D. degrees with specialization in physical, biological, geological, chemical and geophysical oceanography.

All students majoring in oceanography or marine geophysics are required to participate in work at sea for a minimum of eight days during their graduate career.

1. M.A. or M.S. in Oceanography. A minimum of 45 hours including thesis work is required for the master's program. Approximately two-thirds of the work must be taken in the School of Oceanography. In special cases, the thesis requirement may be waived.

No foreign language is required for the M.S. degree. For the M.A. degree, the student must show, by examination or by adequate undergraduate courses (not less than two years), a reading knowledge of one foreign language, usually russian, german or french.

Candidates must pass a two-hour final oral examination in which they defend their theses. Twelve degrees were granted in 1972.

2. Ph.D. in Oceanography. The core courses required for the M.S. or M.A. program are also required for the Ph.D. program. Credits earned in the M.S. or M.A. program may be transferred into the Ph.D. program. The remainder of the Ph.D. program is determined by the individual student and his committee. A student must satisfy the foreign language requirements established by his committee. Ph.D. candidates must pass a written departmental comprehensive examination (based on the oceanography courses), a university preliminary examination on the Ph.D. program, and a final oral thesis defense. Fourteen degrees were granted in 1972.

3. M.S., M.A. and Ph.D. in Geophysics. Programs in geophysics are offered within the School of Oceanography and in cooperation with the Departments of Physics, Geology and Mathematics. A student studying for this degree under this program works out a course of study upon consultation with his committee. This program must include a minimum of three courses in oceanography. Examination procedures and foreign language requirements are the same as for other oceanography degrees. Two Ph.D. degrees were granted in 1972.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Oc 331	Introduction to Oceanography	3

GRADUATE

Oc 442	Marine Zooplankton	3
Oc 443	Marine Zooplankton Laboratory	2
Mb 450	Marine and Freshwater Microbiology	3
Oc 471	Physical Limnology	3
Oc 490	Principles of Biological Oceanography	3
Oc 491	Principles of Physical Oceanography	3
Oc 492	Principles of Geological Oceanography	3
Oc 493	Principles of Chemical Oceanography	3
Oc 501	Research	arr.
Oc 503	Thesis	arr.
Oc 505	Reading and Conference	arr.
Oc 507	Seminar	arr.
Oc 521	Marine Radioecology	3
Oc 529	Special Topics in Marine Radioecology	1-3
Oc 531	Descriptive Physical Oceanography I	4
Oc 532	Descriptive Physical Oceanography II	4
Oc 541	Biological Oceanography	4
Oc 542	Marine Nekton	3
Oc 543	Marine Nekton Laboratory	1
Oc 544	Marine Phytoplankton Ecology	3
Oc 545	Marine Phytoplankton Physiology	3
Oc 546	Marine Primary Production	5
Oc 548	Marine Benthic Ecology	4
Oc 549	Special Topics in Biological Oceanography	1-3
Oc 551	Chemical Oceanography	4
Oc 552	Chemical Oceanography	4
Oc 553	Descriptive Chemical Oceanography	4
Oc 554	Theoretical Chemical Oceanography	4
Oc 559	Special Topics in Chemical Oceanography	1-3
Oc 560	Geological Oceanography	4
Oc 561	Geology and Geophysics of Ocean Basins I	3
Oc 562	Geology and Geophysics of Ocean Basins II	3
Oc 563	Deep-Sea Sediments	3
Oc 564	Mineralogy of Marine Sediments	3
Oc 565	Stratigraphy of Marine Sediments	3
Oc 566	Ecology of Foraminifera	3
Oc 567	Marine Micropaleontology I: Foraminifera	4
Oc 568	Marine Micropaleontology II: Radiolaria and Calcareous Nannoplanktons	4
Oc 569	Special Topics in Geological Oceanography	1-3
Oc 571	Theoretical Physical Oceanography I	4
Oc 572	Theoretical Physical Oceanography II	4
Oc 573	Theoretical Physical Oceanography III	4
Oc 574	Wave Dynamics	4
Oc 575	Marine Hydrodynamics	4
Oc 579	Special Topics in Physical Oceanography	1-3
Oc 581	Theoretical Geophysics: Earth Gravity	3
Oc 582	Theoretical Seismology	3
Oc 583	Earthquake Seismology	3
Oc 584	Physics of the Earth	3
Oc 586	Theoretical Geophysics: Magnetics	3
Oc 589	Special Topics in Geophysics	1-3

The instructional staff for the courses listed above consists of the following:

Blakely, Richard, Ph.D., Research Associate
Bodvarsson, Gunnar, Ph.D., Professor
Burt, Wayne V., Ph.D., D.Sc., Associate Dean of Research
Byrne, John V., Ph.D., Dean, School of Oceanography and Acting Director, Marine Science Center
Caldwell, Douglas R., Ph.D., Assistant Professor
Carey, Andrew G., Jr., Ph.D., Associate Professor
Condon, E.J., B.A., Extension Oceanographer
Corliss, Jack, Ph.D., Assistant Professor

Couch, Richard, Ph.D., Assistant Professor
Crew, Henry, Ph.D., Research Associate
Culberson, Charles, Ph.D., Research Associate
Curl, Herbert, Jr., Ph.D., Professor
Cutshall, Norman, Ph.D., Research Associate
Dymond, Jack, Ph.D., Assistant Professor
Elliott, William P., Ph.D., Research Associate
Forster, William O., Ph.D., Assistant Professor
Frolander, Herbert F., Ph.D., Professor
Gemperle, Mike, M.S., Instructor
Gonor, Jefferson, Ph.D., Assistant Professor
Gordon, Louis I., Ph.D., Instructor
Hancock, Danil, M.S., Instructor
Heath, G. Ross, Ph.D., Associate Professor
Hedgpeth, Joel W., Ph.D., Professor
Heinrichs, Donald, Ph.D., Assistant Professor
Holton, Robert, Ph.D., Research Associate
Ingle, Sara, Ph.D., Research Associate
Johnson, Richard, Ph.D., Assistant Professor
Johnson, Stephen, Ph.D., Assistant Professor
Komar, Paul, Ph.D., Assistant Professor
Kulm, Lavern D., Ph.D., Associate Professor
McCauley, James E., Ph.D., Associate Professor
Mesecar, Roderick S., Ph.D., Assistant Professor
Miller, Charles B., Ph.D., Assistant Professor
Moore, Ted C., Ph.D., Assistant Professor
Morita, Richard, Ph.D., Professor
Nath, John H., Ph.D., Research Associate
Neal, Victor T., Ph.D., Assistant Professor
Neshyba, Stephen J., Ph.D., Associate Professor
Pak, Hasong, Ph.D., Research Associate
Panshin, Daniel, Ph.D., Assistant Professor
Park, P. Kilho, Ph.D., Professor
Paulson, Clayton A., Ph.D., Assistant Professor
Pearcy, William G., Ph.D., Professor
Pillsbury, Dale, Ph.D., Research Associate
Pytkowicz, Ricardo M., Ph.D., Professor
Renfro, William C., Ph.D., Assistant Professor
Richardson, Sara, Ph.D., Research Associate
Scheidegger, Kenneth, Ph.D., Research Associate
Small, Lawrence F., Ph.D., Associate Professor
Smith, Robert L., Ph.D., Associate Professor
Van Andel, Tjeerd H., Ph.D., Professor
Zaneveld, Ronald, Ph.D., Research Associate

To obtain further information, address all inquiries directly to:

Student Advisor
School of Oceanography
Oregon State University
Corvallis, Oregon 97331

The Department of Fisheries and Wildlife is headquartered in the Bioscience Building on the Corvallis campus of Oregon State University. Construction of the Bioscience Building was completed in 1970 and it contains 66,304 net square feet of space for use by the department. Facilities include lecture rooms, teaching and research laboratories, constant temperature rooms, self-learning center, walk-in freezer, shop, ichthyological museum, radiation laboratory, offices for staff and graduate students and numerous supporting facilities.

Research into all aspects of fisheries are carried out at the following facilities which are not located on the Corvallis campus: Brooklane Laboratory, Fairplay Laboratory, Netarts Bay Laboratory, Port Orford Laboratory, Soap Creek Experimental Ponds, Western Kraft Experimental streams, Berry Creek Experimental Stream, Oak Creek Laboratory, Averill Fisheries Laboratory and Pacific Fisheries Laboratory.

The following degrees are offered by the department:

1. B.S. in Fisheries Science. All undergraduate students must complete the following: *Orientation to Fisheries and Wildlife*, Seminar, Principles of Wildlife Conservation, Economic Ichthyology, Fishery Biology, Commercial Fisheries, and 13 hours of recommended departmental courses. Non-departmental requirements include 18 hours of communications, 18 hours in humanities and social sciences with at least one course in economics, and 72 hours in the biological and physical sciences. A total of 192 hours of undergraduate credit is required for the B.S. degree.

2. M.S. in Fisheries Science. All students must complete a program of study totaling not less than 45 term hours including thesis (six to nine term hours) and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major and one-third (15 term hours) in the minor. A residence of one academic year or fair equivalent is required. There is no foreign language requirement for the M.S. degree.

3. Ph.D. in Fisheries Science. The Ph.D. degree is granted primarily for attainments and proved ability. There is no rigid credit requirement; however, the equivalent of at least three years full-time graduate work beyond the bachelor's degree is required. At least one academic year must be spent in continuous residence at OSU with a minimum of 36 hours of graduate work. The foreign language requirement is determined by the student's doctoral committee subject to approval by the major department and the dean of the Graduate School. A comprehensive preliminary examination is required for admission to candidacy for the Ph.D. degree. Every candidate must submit a thesis embodying the results of research and giving evidence of originality and ability in independent investigation (usually 30-45 term hours). All candidates must pass a final examination, part of which must be oral.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

313	Economic Ichthyology	5
314	Economic Ichthyology	4
315	Aquaculture	3

GRADUATE

454	Fishery Biology	5
455	Fish Culture	3
456	Fishery Limnology	3
457	Fishery Limnology Laboratory	2
465	Commercial Fisheries	5
466	Invertebrate Fisheries	4
470	Water Pollution Biology	3
490	Parasites and Diseases of Fish	5
555	Fish Genetics	3
561	Theory of Exploitation of Fish and Shellfish	4
567	Research Perspectives	4
568	Research Perspectives	4
569	Population Dynamics	4
570	Pollution Problems in Fisheries	3
571	Functional Ichthyology	3
572	Systematics of Fishes	3
573	Topics in Ichthyology	3

The instructional staff for the courses listed above consists of the following:

Bond, Carl E., Ph.D., Professor
Davis, Gerald E., Ph.D., Associate Professor
Donaldson, John R., Ph.D., Associate Professor
Doudoroff, Peter, Ph.D., Professor
Fisher, R. Barry, M.A., Associate Professor
Hall, James D., Ph.D., Associate Professor
Horton, Howard F., Ph.D., Professor
Juntunen, Erland T., B.S., Senior Instructor
McIntyre, John D., Ph.D., Assistant Professor
Millemann, Raymond E., Ph.D., Professor
Shumway, Dean L., M.S., Associate Professor
Simon, Raymond C., Ph.D., Professor
Warren, Charles E., Ph.D., Professor and Acting Department Head
Weber, Lavern J., Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Charles E. Warren, Acting Head
Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon 97331

The Department of Food Science and Technology is housed in two modern buildings on the Corvallis campus. These buildings contain 78,000 square feet of office, teaching and research laboratory and pilot plant space. The facilities are designed and well equipped to carry out teaching and research activities peculiar to most areas in the food field.

A newly constructed Seafoods Laboratory is located at Astoria, Oregon, on the Columbia-Youngs River estuary. This research center has been operated as an integral part of the department since 1940. The facility provides 7,000 square feet of laboratory and office space and serves as a center for marine food science research.

Adjacent to the central university campus, the department operates the Food Toxicology and Nutrition Laboratory. This laboratory is expecially designed for studies of toxicity, nutrition and carcinogenesis in fish. Its 5,500 square feet of laboratory and office space includes a complete histopathological laboratory and 140 separate fish rearing tanks abundantly supplied with a constant temperature water supply.

Food science and technology is the application of the sciences and engineering to the manufacture, preservation, storage, transportation and consumer use of food products. The food science program is concerned with the science and research involving the chemical, physical, biological, microbiological, toxicological and nutritive properties of foods.

The university offers the following degrees in food science and technology:

1. B.S. in Food Science and Technology. The minimum course requirements consist of the following: Food Science and Technology, Communications, Humanities and Social Sciences, Biological and Physical Sciences, Physical Education, and electives, for a total of 174 term hours.

2. M.S. in Food Science. Students must complete a program of study totaling not less than 45 term hours including thesis and courses approved for graduate credit. Approximately two-thirds of the work (30 term hours) must be in the major or be composed of courses approved by the major department in the basic sciences and one-third (15 term hours) in the minor. Three credit hours of seminar are recommended with the thesis representing 9 to 12 hours of major credit, which must be the result of the student's independent research and preparation. No qualifying examination is required for the M.S. degree. A final oral examination of not less than two hours is required for presentation of the student's thesis and examination of this thesis and field of study.

2. Ph.D. in Food Science. The degree of Ph.D. is granted primarily for attainments and proved ability and prepares the student for research in a specialized field of study. A M.S. degree or equivalent (as evaluated by the graduate faculty of the department) is required for a student who intends to work toward a Ph.D. degree. The student and his major professor formulate the Ph.D. study program. The Ph.D. program usually consists of 75 to 85 term hours beyond that required for a M.S. degree and is composed of approximately two-third's formal course work and one-third thesis research. For the Ph.D. degree, the student's doctoral committee determines on the basis of the student's needs and the foreign language scientific literature in his field of specialization if two, one or no foreign language will be required or permitted. If no foreign language requirement is recommended by the student's doctoral committee, the foreign language requirement will be satisfied by, one, the taking of a course or courses (undergraduate or graduate) which are in subjects not usually included for credit in the major or minor and which will have as their purpose the broadening of the student or to provide a "tool" of particular value, and/or two, a special project, other than laboratory research, which would distinctly benefit the student. Written and oral preliminary examinations are required. A thesis which is the result of the student's independent research and preparation is required to demonstrate an independent research capability. The candidate is expected to defend his thesis and knowledge of his field in a final oral examination.

The following courses are offered in conjunction with the above programs.

FST 111	Food Quality Evaluation	2
FST 221	Food Processing	3
FST 222	Food Processing	4
FST 223	Food Processing	3
FST 224	Food Processing Laboratory	2
FST 271	Food Grades and Sanitation	2
FST 411	Food Science	3
FST 412	Food Science	3
FST 413	Food Science	4
FST 421	Federal and State Food Regulations	2
FST 423	Food Analysis	
FST 424	Quality Control Systems	3
FST 431	Food Packaging	3
AET 441	Food Engineering	3
AET 442	Food Engineering	3
AET 443	Food Engineering	3
Mb 440	Microbial Contamination Control	4
Mb 442	Dairy Microbiology	4
Mb 444	Food Microbiology	4
FST 401	Research	--
FST 403	Thesis	--
FST 405	Reading and Conference	--
FST 407	Seminar	1
FST 501	Research	--
FST 503	Thesis	--
FST 505	Reading and Conference	--
FST 507	Seminar	1
FST 531	Carbohydrates in Foods	3
FST 532	Food Flavors and Evaluation	3
FST 533	Lipids in Foods	3
FST 551	Food Preservation	4
FST 561	Pigments and Color Evaluation	3
FST 562	Proteins in Foods	3
FST 563	Enzymes of Foods	3

The instructional staff for the courses listed above consists of the following:

Anderson, Arthur W., Ph.D., Professor of Microbiology
Anglemier, Allen F., Ph.D., Associate Professor of Food Science
Babbitt, Jerry K., Ph.D., Research Associate, Food Science
Beavers, Darrell V., B.S., Assistant Professor of Food Science
Bills, Donald D., Ph.D., Associate Professor of Food Science
Bodyfelt, Floyd W., M.S., Assistant Professor of Food Science
Boester, Dean E., M.S., Associate Professor of Agricultural Engineering
Caln, Robert F., Ph.D., Professor of Food Science
Childs, Ernest A., Ph.D., Research Associate, Food Science
Crawford, David L., Ph.D., Associate Professor of Food Science
Elliker, Paul R., Ph.D., Department Chairman and Professor of Microbiology
Hilderbrand, Kenneth H., M.S., Assistant Professor of Food Science
Kirk, Dale E., M.S., Professor of Agricultural Engineering
Krumperman, Paul H., Ph.D., Associate Professor of Food Science

Law, Duncan K., B.S., Associate Professor of Food Science
Lee, Donald J., Ph.D., Research Associate, Food Science
Lee, Jong S., Ph.D., Research Associate, Food Science
Libbey, Leonard M., Ph.D., Associate Professor of Food Science
McGill, Lois S., B.S., Professor of Food Science
Montgomery, Morris W., Ph.D., Associate Professor of Food Science
Morgan, Max E., Ph.D., Professor of Food Science
Nixon, Joseph E., Ph.D., Research Associate, Food Science
Pawlowski, Norman E., Ph.D., Research Associate, Food Science
Samuels, Clifford E., Ph.D., Professor of Food Science
Sandine, William E., Ph.D., Professor of Microbiology
Scanlan, Richard A., Ph.D., Associate Professor of Food Science
Schultz, Harold W., Ph.D., Department Head and Professor of Food Science
Sinnhuber, Russell O., M.S., Professor of Food Science
Soderquist, Michael R., M.S., Instructor in Food Science
Verseveld, George W., M.S., Assistant Professor of Food Science
Wales, Joseph H., M.A., Associate Professor of Food Science
Wrolstad, Ronald E., Ph.D., Associate Professor of Food Science
Yang, Hoya H., Ph.D., Associate Professor of Food Science
Yu, Teh C., M.S., Associate Professor of Food Science

To obtain further information, address all inquiries directly to:

Dr. Harold W. Schultz, Head
Department of Food Science and Technology
Oregon State University
Corvallis, Oregon 97331
(503) 754-3131

The School of Engineering has a variety of specialized laboratories and complementary facilities for use in the ocean engineering research and training programs. The following major facilities are used for student training and research needs: environmental fluid dynamics laboratory wave basin, hydraulic laboratory, fluid measurements laboratory, hydrologic facilities, marine science center engineering laboratory, sanitary engineering laboratories, photogrammetry laboratory, soil mechanics laboratory, structural engineering laboratory, engineering materials laboratory, mechanical engineering laboratory, instrumentation laboratory, electrochemical engineering laboratory, underwater acoustics laboratory and simulation laboratory (with an EAI 690 hybrid computer).

The computer center, oceanography laboratories, radiation center and the Marine Science Center are also extensively used in the ocean engineering program, together with vessels of the Oceanography Department and facilities of the Pacific Northwest Water Laboratory of the Environmental Protection Agency.

The principal research areas for studies on estuarine hydraulics, water resources and ocean engineering are the rivers, lakes reservoirs, estuaries and coast of Oregon. Where convenient, temporary field research offices have been established; in other cases, departmental vehicles and ocean engineering boats (six craft up to 25 feet long) have provided temporary instrument shelters for environmental research.

A new facility for the study of ocean waves and their effect on coastal and nearshore structures is soon to be completed on the OSU campus. The concrete wave tank will be 342 feet long, 12 feet wide and 15 feet deep. The wave basin is the first phase in the construction of an Environmental Fluid Dynamics Laboratory.

Graduate study in ocean engineering is offered at Oregon State University through the School of Engineering. This program of study leads to the degrees of Master of Ocean Engineering or Master of Science and Doctor of Philosophy in engineering with an emphasis on ocean engineering. The graduate student in ocean engineering, depending on his specific interests, is admitted to an established department in the School of Engineering: civil, chemical, electrical, industrial, mechanical and metallurgical or nuclear engineering. A program of study is then designed to fit the individual's professional objectives and to achieve a high degree of engineering competence related to the ocean environment. The following requirements are to be met in obtaining a degree through the ocean engineering program:

Major: An area of ocean engineering specialization within one or more of the established engineering disciplines. Minor: Supporting course work in ocean engineering and/or oceanography plus other appropriate courses to prepare the student for professional work in the ocean-oriented industries and agencies. Thesis research: Each student must conduct research and prepare a thesis on a pertinent subject concerning engineering in the marine environment. Program of study: The program must meet approval of the ocean engineering committee of the School of Engineering.

The Ph.D. program requires at least three years of study beyond the baccalaureate degree and includes about 135 quarter credit hours of course and thesis work. The Master of Ocean Engineering and the Master of Science in Engineering degrees require 45 quarter credit hours, including research.

The following courses are offered in conjunction with the above programs:

GRADUATE

CE 521	Hydraulic Systems	3
CE 524	Sediment Transport	3
CE 525	River Control and Utilization	3
CE 526	Hydraulics of Open Channels	3
CE 531	Analysis of Engineering Structures	3
CE 532	Matrix Methods of Structural Analysis	3
CE 533	Structural Stability	3
CE 540, 541	Sanitary Engineering Processes	3, 3
CE 544	Water Quality Analysis	3
CE 548	Water Quality Dynamics	3
CE 566	Ocean Position Surveying	3
CE 570	Coastal Hydraulics	3
CE 572	Estuarine Transport	3
CE 573	Ocean Engineering Design	3
CE 574	Ocean Engineering Facilities Planning	3
CE 578	Marine Geotechnique	3
CE 579	Special Topics in Ocean Engineering	1
ChE 514	Fluid Flow	3
Che 520, 521	Diffusional Operations	3, 3
ChE 522	Heat Transmission	3
ChE 535	Corrosion and Corrosion Control	3
ChE 537, 538, 539	Thermodynamics	3, 3, 3
ChE 540	Applied Reaction Kinetics	3
ChE 550	Process Systems Analysis	3
ChE 551	Process System Optimization	3
EE 414, 415, 416	Systems Instrumentation	3, 3, 3
EE 421, 422	Transmission Systems	3, 3
EE 451, 452, 453	System Engineering	3, 3, 3
EE 461, 462, 463	Communication Engineering	3, 3, 3
EE 471, 472, 473	Logical Design and Digital System Engineering	3, 3, 3
EE 491, 492, 493	Control Engineering	3, 3, 3
EE 514, 515, 516	Advanced Solid State Electronics	3, 3, 3

EE 525 526, 527	Computer Systems	3, 3, 3
EE 551, 552, 553	Microwave Circuits	3, 3, 3
EE 554, 555	Control Systems	3, 3
EE 556, 557, 558	Multivariable Systems	3, 3, 3
EE 560	Signals and Noise	3
EE 561, 562	Communication Systems	3, 3
EE 590, 591, 592	Systems Simulation	3, 3, 3
EE 593	Simulation Fundamentals	3
EE 507	Ultra Sonics Seminar	--
IE 441	Environmental Design	3
IE 471, 472	Management Models	3, 3
IE 491	Quality and Reliability Control	4
IE 505	Marine Work Design	--
IE 521, 522, 523	Selected Topics in Industrial Engineering	3, 3, 3
IE 571, 572, 573	Systems Theory and Cybernetics	3, 3, 3
ME 416	Applied Mechanics	3
ME 417, 418	Statics of Deformable Structures	3, 3
ME 431, 432	Power Plant Engineering	3, 3
ME 477	Measurement and Control of Sound	3
ME 480, 481, 482	Dynamics of Physical Systems	3, 3, 3
ME 514, 515	Mechanical Design	3, 3
ME 516, 517	Systems Engineering	3, 3
ME 525, 526	Thermodynamics	3, 3
ME 531	Selected Topics in Thermodynamics	3
ME 527, 528, 529	Heat Transfer	3, 3, 3
ME 550	Continuum Mechanics	3
ME 551, 552	Elasticity	3, 3
ME 557	Incompressible Fluid Mechanics	3
ME 559	Selected Topics in Fluid Mechanics	3
ME 560	Experimental Mechanics	3
ME 566, 567, 568	Advanced Dynamics	3, 3, 3
ME 573	Numerical Methods for Engineering Analysis	3
MetE 545, 546, 547	Selected Topics in Materials Science	3, 3, 3
MetE 555	Electron Microscopy in Materials Science	3
MetE 556	Advanced Electron Microscopy	3

Professional staff available for the graduate training program in ocean engineering include:

CHEMICAL ENGINEERING

Elzy, E., Ph.D., Associate Professor
Fitzgerald, T., Ph.D., Associate Professor
Knudsen, J.G., Ph.D., Professor and Associate Dean, Director EES
Levenspiel, O., Ph.D., Professor
Meredith, R.E., Ph.D., Associate Professor
Mrazek, R.V., Ph.D., Professor
Wicks, C.E., Professor and Head

CIVIL ENGINEERING

Bella, D.A., Ph.D., Associate Professor
Bell, J.R., Ph.D., Professor
Klingeman, P.C., Ph.D. Associate Professor
Layton, R., Ph.D., Associate Professor
Montes, S., Ph.D., Assistant Professor

Phillips, D.C., Ph.D., Professor
Schaumburg, F.D., Associate Professor and Head
Schroeder, W.L., Ph.D., Associate Professor
Seaders, J., M.S., Associate Professor
Slotta, L.S., Ph.D., Associate Professor
Sollitt, C.K., Ph.D., Assistant Professor
Yamamoto, T., Ph.D., Research Associate

ELECTRICAL AND ELECTRONICS ENGINEERING

Jensen, L.C., M.S., Associate Professor
Michael, R.R., M.S., Professor
Mohler, R.R., Ph.D., Professor and Head
Rink, R.E., Ph.D., Associate Professor
Saugen, J.S., Ph.D., Associate Professor
Weber, L.J., M.S., Professor

INDUSTRIAL ENGINEERING

Croff, H.L., M.S., Assistant Professor
Engesser, W.F., M.S., Professor
Inoue, M.S., Ph.D., Professor
Love, S., Ph.D., Assistant Professor
Riggs, J.L., Ph.D., Professor and Head

MECHANICAL AND METALLURGICAL ENGINEERING

Bainbridge, D.W., Ph.D., Professor
Bucy, D., M.S., Associate Professor
Dahlke, H.J., Ph.D., Associate Professor
Davis, L.R., Ph.D., Associate Professor
Johnson, L.E., Ph.D., Associate Professor
McComb, J.A., M.S., Assistant Professor
McMullen, W.D., Ph.D., Associate Professor
Mingle, J.G., M.S., Professor
Nath, J.H., Ph.D., Professor
Olleman, R.D., Ph.D., Professor
Smith, C.E., Ph.D., Associate Professor
Thresher, R.W., Ph.D., Assistant Professor
Welty, J.R., Ph.D., Professor and Head
Wilson, R.E., Ph.D., Professor
Zaworski, R.J., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Dr. Larry S. Slotta, Director
Ocean Engineering Programs
School of Engineering
Oregon State University
Corvallis, Oregon 97331

UNIVERSITY OF THE PACIFIC
PACIFIC MARINE STATION
Dillon Beach, California 94929

The marine station lies 60 miles north of San Francisco on the southern shore of Bodega Bay adjacent to Tomales Bay and just opposite the Point Reyes National Seashore. The high diversity of marine environments close by renders the area very suitable as a laboratory site. Sand beaches, intertidal sand flats, rocky shores, salt marsh, and kelp beds are within easy access. The local flora and fauna are correspondingly rich.

The station consists of three research and office buildings and several auxiliary structures; the former house teaching, research and instrument laboratories, photographic darkroom, museum, stockroom, and library. All laboratories are supplied with fresh seawater pumped directly from the ocean to two large holding tanks. The station maintains two research vessels: a 17-foot Boston Whaler and a new 42-foot steel-hull vessel designed for offshore research.

GRADUATE PROGRAM

The Pacific Marine Station, a division of the University of the Pacific, is a year-round research center with a graduate program leading to a Master of Science degree.

Twelve years ago, the marine station began a program of research, stressing ecology and systematics in the broadest sense. The principal theme of the ecology program is to determine the factors responsible for the seasonal and long-term changes in marine ecosystems. Current studies range from analyzing the effects of a variety of physical stresses on sand flat communities to evaluating the role of predation in determining gastropod distribution on rocky shores. This program supplies the information necessary to develop sound impact studies and to evaluate the disturbances caused by man. The ecology program provides both background data and a broader context for other scientific programs.

Studies on the functional morphology of marine organisms are aimed at a better understanding of the interrelationships between organ systems and environmental conditions. These studies are currently focused on more complete knowledge of feeding and nutritional biology in marine invertebrates, larvae, and the ecological implications of larval biology.

Graduate students are encouraged to participate in the research programs underway at the station. Research assistants work 50 percent of their time on the various projects. From their contact with staff members and the multitude of research problems that come to their attention during their involvement in the various ecology research programs, students have little difficulty in finding thesis problems.

UNDERGRADUATE PROGRAM

The undergraduate program in marine science is designed for students of biology with upperclass standing. The 16 semester units are partitioned between two of the formal four-unit courses offered and eight units of research, normally on a specific problem related to one of the current research programs at the pacific marine station. There are three main objectives of this program.

First, it affords undergraduates the opportunity of having a marine experience, of studying marine biology and ecology at the source.

Secondly, the program provides an opportunity to carry on original research either within the context of one of the current faculty research programs or in some other area.

Finally, it is hoped that the scientific experience gained during this semester will enable an individual to give thoughtful consideration to all of the parameters of complex environmental problems.

Upon completion of the program it is expected that a student will be able to: understand some of the complex relationships between species of animals, substrata, food chains, larval development and morphological adaptations; evaluate the scientific basis for statements in newspapers and magazines on conservation and the development of the natural resources; design a limited research program, and know how to apply scientific results to the solution of environmental problems.

Undergraduate students with advanced standing in biology will take two courses selected from those offered and spend the other two courses in participation in one of the station's on-going research projects. Departures from this scheme, including initiation of new projects, is possible by special arrangement.

Course credit will fit into the undergraduate program through the University of the Pacific. Application deadlines are April 1 and November 1.

The following courses are offered each year:

Fall Semester

Biometrics
Invertebrate Zoology
General Oceanography
Advanced Invertebrate Zoology
Evolution Seminar

Spring Semester

Ecology
Invertebrate Zoology
Physiology of Marine Animals
Invertebrate Embryology
Evolution Seminar

Summer Courses

*Invertebrate Zoology
Icthyology
*Marine Ecology
Phycology
*Marine Geology
*Offered summer, 1973

In addition, two units special topics courses may be offered on demand in such subject areas as: systematics, photographic techniques, computer programming, and scientific illustration.

Instructional staff for the courses listed above consists of the following:

Eric Armitage, J. D., Business Manager, Research Associate
James A. Blake, Ph. D., Assistant Director, Assistant Professor of Zoology. Development of marine invertebrates, taxonomy of polychaeta
William M. Kaill, Ph. D., Assistant Professor of Biology. Coordinator-undergraduate program.
Victor L. Loosanoff, Ph. D., Adjunct Professor of Marine Biology, mariculture.
Steven Obrebski, Ph. D., Assistant Professor of Ecology, Ecology and evolution of marine invertebrates; computer simulation models
Edmund H. Smith, Ph. D., Director, Professor of Zoology, functional morphology of mollusca.

PENINSULA COLLEGE
Port Angeles, Washington

The fisheries building is an integrated unit comprised of one classroom, one lab-classroom, office for two instructors, an equipment room, museum and workshop. A large covered area on one side furnishes shelter for boats, nets and other large equipment. Located on the campus is a 16 by 20-foot hatchery building capable of raising 250, 000 fish to the fry stage. Two 15-foot circular cement ponds outside the building are used to hold fish until ready to plant. A small fishing boat, rehabilitated by the class, is also part of the equipment.

The degree of Associate of Applied Arts (Fisheries Certificate) is offered.

The following courses are offered in conjunction with the above program:

Chem 31	Technical Chemistry	3
Chem 41	Technical Chemistry	3
Chem 51	Technical Chemistry	3
Fish 33	Taxonomy of Fishes	4
Fish 35	Hatchery Methods	2
Fish 45	Hatchery Methods	2
Fish 55	Hatchery Methods	2
Fish 43	Life History of Fishes	3
Fish 46	Technical Report Writing	2
Fish 56	Technical Report Writing	2
Fish 54	Population Studies	3
Fish 70	Technical Trigonometry	3
Fish 72	Fish Diseases	3
Fish 73	Fish Farming	4

Fish	74	Aquatic Environments	3
Fish	80	Technical Statistics	3
Fish	90	Technical Statistics	3
Fish	82	Wildlife Management	4
Fish	83	Commercial Fisheries	4
Fish	91	Aquatic Insects	4
Fish	92	Marine Invertebrates	4
Fish	95	Microtechnique	4
Fish	96	Study Collections	2

The instructional staff for the courses listed above consists of the following:

FISHERIES DEPARTMENT

Grinols, Richard B., M.S., Instructor
Mausolf, Robert G., B.S., Instructor
Well, Donald R., B.S., Instructor

To obtain further information, address all inquiries directly to:
Registrar
Peninsula College
Port Angeles, Washington 98362

THE PENNSYLVANIA STATE UNIVERSITY
University Park, Pennsylvania 16802

The following specialized facilities are available at the university laboratory in marine geology, special meteorological equipment for courses in marine meteorology, special aquaria and field stations for the cultivation and study of fresh water fish and laboratory for underwater acoustics. In addition, the university is a member of the Marine Science Consortium of Pennsylvania colleges and universities, and through the consortium has access to facilities at Lewes, Delaware, and Wallops Station, Virginia.

No formal degree programs are offered in marine science. A marine science concentration area is available to students in allied major fields. Baccalaureate and advanced degrees are offered in the allied fields of geological sciences (geology, geophysics, mineralogy, and geochemistry), meteorology, geography, biology and physics. Students who are candidates for degrees in these disciplines can schedule certain courses in the marine sciences.

Spring Field Term. Students in the above field may participate in a spring term of ten weeks of field courses conducted by some of the faculty at the Wallops Station site of the Marine Science Consortium.

The following courses are offered in conjunction with the above programs:

MARINE SCIENCES CONCENTRATION

Core Courses

Bio	480	Marine Biology	4
Geol	440	Marine Geology	3
Met	320	The Oceans	2
Or			
Met	407	Elements of Physical Oceanography	3

(plus six credits of approved field courses at a marine field station)

DEPARTMENT OF AEROSPACE ENGINEERING

Aersp	412	Turbulent Flow	3
Aersp	514	Stability of Laminar Flows	3
Aersp	515	Foundations of Turbulence	3
Aersp	516	Homogeneous Turbulence	3
Aersp	517	Inhomogeneous Turbulence	3
Aersp	597C	Geophysical Fluid Dynamics	3

DEPARTMENT OF BIOLOGY

Bio	410	General Limnology	3
Bio	480	Marine Biology	4
Bio	481	Aquatic Botany	3

DEPARTMENT OF CIVIL ENGINEERING

C. E.	579	Aquatic Microbiology	3

COLLEGE OF ENGINEERING

Engr	498	Field Methods in Physical Oceanography	4

ENGINEERING ACOUSTICS PROGRAM

E. Acs.	511	Underwater Sound Propagation	3
E. Acs.	515	Acoustics in Fluid Media	3

DEPARTMENT OF GEOCHEMISTRY

Gchem	522	Geochemistry of Aqueous Systems	3

DEPARTMENT OF GEOLOGY

Geol	440	Marine Geology	3
Geol	540	Chemical Oceanography	3

DEPARTMENT OF METEOROLOGY

Met	320	The Oceans	2
Met	407	Elements of Physical Oceanography	3
Met	445	Hycrology for Meteorologists	3
Met	507	Dynamic Oceanography	2

DEPARTMENT OF MICROBIOLOGY

Micro	529	Aquatic Microbiology	3

DEPARTMENT OF PHYSICS

Phys	443	Intermediate Acoustics	3
Phys	533	Theoretical Acoustics	3

Courses carrying a 400 number may be scheduled by undergraduate and graduate students; those carrying a 500 number can be scheduled only by graduate students.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF AEROSPACE ENGINEERING

Allen, John S., Jr., Ph.D., Assistant Professor
Lumley, John L., Ph.D., Professor

APPLIED RESEARCH LABORATORY

Farwell, Robert W., Ph.D., Associate Professor of Engineering Research
Leiss, William J., B.S., P.E., Associate Professor of Engineering Research
Welser, Edward V., Jr., M.S., Research Associate
Whitmarsh, David C., Jr., Associate Professor of Engineering Research

DEPARTMENT OF ARCHITECTURAL ENGINEERING

Tichy, Jiri, D.Sc., Associate Professor

DEPARTMENT OF BIOLOGY

Butler, Robert L., Ph.D., Associate Professor of Zoology

Cooper, Edwin L., Ph. D., Professor of Zoology
Dunson, William A., Ph. D., Associate Professor

DEPARTMENT OF CIVIL ENGINEERING

Unz, Richard F., Ph. D., Associate Professor of Sanitary Microbiology

DEPARTMENT OF GEOCHEMISTRY

Barnes, Hubert L., Ph. D., Professor

DEPARTMENT OF GEOLOGY

Guber, Albert L., Ph. D., Associate Professor
Schmalz, Robert F., Ph. D., Professor
Weber, Jon N., Ph. D., Associate Professor of Marine Geology

DEPARTMENT OF METEOROLOGY

Blackadar, Alfred K., Ph. D., Professor
Panofsky, Hans A., Ph. D., Professor of Atmospheric Sciences

DEPARTMENT OF PHYSICS

Skudrzyk, Eugene, A. G. C. G. I., Ph. D., Habil., Professor

To obtain further information, address all inquiries directly to:

Dean Walter G. Braun
Assistant Dean of Engineering
101 Hammond Building
The Pennsylvania State University
University Park, Pennsylvania 16802

-Or-

Dean E. S. Lindstrom
Associate Dean of Science
214 Whitmore Laboratory
The Pennsylvania State University
University Park, Pennsylvania 16802

POMONA COLLEGE
Claremont, California 91711

Facilities for undergraduate study in marine science include the undergraduate teaching and research laboratories in botany, geology, physics and zoology. Research equipment includes apparatus for analyzing chemical and physical properties of the marine environment, such as oxygen and other dissolved gases, salinity, chlorinity, other specific ions, trace nutrients, and pH; centrifuges, and a continuous-flow centrifuge, vapor-pressure osmometer; spectrophotometers; flame photometers; equipment for X-ray diffraction, X-ray fluorescence spectrography, electron microprobe analysis, and atomic absorption analysis; gas and liquid chromatography; electron, phase-contrast, fluorescence, compound, and dissecting microscopes; photography equipment, including an underwater Nikonos camera and complete darkroom facilities; walk-in constant temperature and controlled-environment rooms; a recirculating sea-water aquarium system with nine 35-gallon aquaria, two 250-gallon capacity storage tanks, and filtration and cooling units. A well-equipped shop is available for construction of specialized equipment, including electronic. An IBM System/360 Model 40 computer with 128 K characters of storage, three disk drives, four tape drives, one printer, one card reader/punch, and a Calcomp plotter is available for student and faculty use in teaching and research. Field equipment available inclu des a variety of plankton nets, biological grabs and dredges, water samplers, etc. There is ready access to the R/V Vantuna, an 85-foot tuna clipper equipped with a wide variety of equipment for research and teaching in biological, physical, chemical, and geological oceanography.

Pomona College is a four-year liberal arts college, offering the Bachelor of Arts degree in a number of fields. In the sciences, basic background and broad knowledge are emphasized, rather than specialization in particular narrow fields. About four to six students each year graduate with a B. A. degree in fields related to marine science and go on to graduate study. In addition to the more standard concentrations in botany, botany-biology, geology, physics and zoology, special concentrations such as botany-zoology, zoology-mathematics and marine biology have been arranged for individual students. Thirty-two courses (128 semester hours) are required for the B. A. degree, with distribution depending on the concentration chosen. Usually about one-fourth to one-third of the program must be within the major field and closely related fields.

The following courses are offered in conjunction with the above program:

Bot 100	Algae and Fungi	4
Bot 103	Environmental Botany	4
Bot 113	Plant Ecology	4
Bot 149	Seminar: Botany and Related Fields	4
Bot 199	Botanical Problems	4
Geo 54	Geological Oceanography	4
Geo 107	Geophysics and Global Tectonics	4
Geo 159	Stratigraphy and Sedimentation	4
Geo 199	Selected Topics in Geology	4
Phy 4	Introductory Oceanography	4
Phy 190	Contemporary Topics in Physics	4
Phy 199	Independent Study and Research (The following types of work, with faculty guidance, are available: independent study of advanced subjects not treated in other courses of the department; independent or collaborative research for which funds and equipment are available; or senior thesis.)	4
Zoo 100	Aquatic Biology	4
Zoo 151	Invertebrate Zoology	4
Zoo 189	Seminars in Selected Topics in Zoology	4
Zoo 199	Introduction to Research in Zoology	4

Courses offered in the joint sciences department of Scripps, Claremont Men's, and Pitzer Colleges, in which Pomona students may cross-register, are:

Bio 146	Ecology
Bio 167	Thermo-Biology
Bio 169	Topics in Marine Biology
ES 63	Environmental Policy
ES 65	Environmental Problems
ES 191	Seminar in Environmental Studies

The instructional faculty for the courses listed above consists of the following:

BOTANY

Benson, Lyman, Ph. D., H. K. W. Bent Professor
Phillips, Edwin A., Ph. D., Professor

GEOLOGY

McIntyre, Donald B., Ph. D., Professor
Zenger, Donald, Ph. D., Associate Professor

PHYSICS

Miller, Jack C., Ph. D., Professor

ZOOLOGY

Oglesby, Larry C., Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Larry C. Oglesby
Zoology Department
Pomona College
Claremont, California 91711
(714) 626-8511, ex. 2950/2948

PRINCETON UNIVERSITY
Princeton, New Jersey

Major facilities include an IBM 360/91 computer, radio-chemistry laboratory, electron microprobe, X-ray equipment and field recording instruments. The National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory is located on campus and a joint program in atmospheric sciences and physical oceanography is offered. Princeton possesses no unique marine facility, but cooperative arrangements with other institutions are made for ship and shore facilites.

The following degrees are offered:

1. Ph. D. In Marine Geology (Department of Geological and Geophysical Sciences). All students are expected to have a broad knowledge of geology/geophysics with special emphasis on a marine topic. Topics currently pursued by the department are sea floor spreading, processes of trenches and mountain building, marine magnetics, reflection seismology, sediment deposition, evolution of ocean's chemistry, carbonate sedimentation, and invertebrate paleontology. There are no course requirements but all students must satisfactorily complete a comprehensive examination and demonstrate a capacity for independent research by completing a thesis project. A reading knowledge of two foreign languages is required.

2. Ph. D. In Physical Oceanography (Geophysical Fluid Dynamics Program). Three participatin departments, Aerospace and Mechanical Sciences, Civil and Geological Engineering, and Geological and Geophysical Sciences, cooperate in this joint program. Advanced study and research in the program is carried out in collaboration with the Geophysical Fluid Dynamics Laboratory of NOAA. Research projects in the following areas are emphasized: Large scale theory of circulation in atmosphere, ocean and interior of the earth, boundary layer problems, thermal convection, geophysical turbulence, transport properties, thermal budget, planetary atmospheres, and wave phenomena. Large scale computing facilities are available for the study and simulation of these problems. A plan of course work and research will be worked out by the student and his adviser. The student must have a knowledge of one foreign language, pass the general examination (usually after two years of study), and present an acceptable dissertation.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF GEOLOGICAL AND GEOPHYSICAL SCIENCES

GRADUATE

507	Regional Structural Geology
508	Principles of Sedimentology
517	Invertebrate Paleontology
518	Invertebrate Paleontology
519	Geology of Continental Margins
523	Geochemistry of the Atmosphere and Oceans
530	Chemical Sediments
532	Petrology Seminar
535	Special Topics in Geophysics

GEOPHYSICAL FLUID DYNAMICS PROGRAM

GRADUATE

501	Introduction to Geophysical Fluid Dynamics
502	Introduction to Geophysical Fluid Dynamics
503	Physical Oceanography
504	Dynamical Climatology
505	Dynamic Prediction
506	Special Topics in Geophysical Fluid Dynamics

The instructional staff for the courses listed above consist of the following:

Bonini, William E., Ph. D., Professor Geological Engineering
Bryan, Kirk, Ph. D., Professor, Physical Oceanography
Burk, Creighton A., Ph. D., Professor, Regional Geology
Dahlen, Anthony F., Ph.D., Assistant Professor, Geophysics
Deffeyes, Kenneth S., Ph. D., Associate Professor, Marine Geology
Dorf, Erling, Ph. D., Professor, Paleobotany and Stratigraphy
Fischer, Alfred G., Ph. D., Professor, Regional Geology and Invertebrate Paleontology
Hargraves, Robert B., Ph. D., Associate Professor Petrology and Rock Magnetism
Hedberg, Hollis D., Ph. D., Professor, Geochemistry
Holland, Henrich D., Ph. D., Professor, Geochemistry
Hollister, Lincoln S., Ph. D. Assistant Professor, Petrology
Jepsen, Glenn L., Ph. D., Professor, Vertebrate Paleontology
Judson, Sheldon, Ph. D., Chairman and Professor, Geomorphology
Kinsman, David J. J., Ph. D. Associate Professor, Carbonate Sedimentation
Morgan, W. Jason, Ph. D., Assistant Professor, Marine Gerphysics
Phinney, Robert A., Professor, Geophysics
Smagorinsky, Joseph, Ph. D., Professor, Atmospheric Sciences
Stegen, Gilbert R., Ph. D., Assistant Professor, Physical Ocenaography
Van Houten, Franklyn B., Ph. D., Professor Sedimentology.
Waldbaum, David S., Ph.D., Associate Professor, Geochemistry

GEOPHYSICAL FLUID DYNAMICS PROGRAM

Bryan, Krik, Ph. D., Professor, Physical Oceanography
Manabe, Sykuro, Ph.D., Professor, Atmospheric Sciences
Mattingly, George E., Ph. D., Assistant Professor Hydrodynamics
Mellor, George L., Ph. D., Director and Professor Fluid Dynamics
Miyakada, Kikuro, Ph. D., Professor, Atmospheric Sciences
Phinney, Robert A., Ph. D., Professor, Geophysics

Smagorinsky, Joseph, Ph. D., Professor, Atmospheric Sciences
Stegen, Gilbert, Ph. S., Assistant Professor, Physical Oceanography

To obtain further information, address all inquires directly to:

Dean of the Graduate School
Princeton University
Princeton, New Jersey 08540

RICE UNIVERSITY
Houston, Texas

Rice's current activity in marine science is based on a continuing study of the marine environment and the geological processes affecting the shore, shelf, and continental slope and basin of the Gulf of Mexico and in the Caribbean Sea. Studies include a general investigation of the continental shelf and shoreline sediments, and the biological components of the sediment. The marine geophysics program is concerned with the properties of the crust in the Gulf and Caribbean regions. The geological processes of the formation of adjacent land masses are also studied and compared to the modern processes.

The Department of Geology is equipped with laboratory facilities and oceanographic instrumentation for marine geology and geophysical measurements. This includes a seismic profiling system with air gun, sparker and crystal sound sources; thermoprobes; a proton magnetometer and various bottom sampling devices. The Department of Geology owns a cabin cruiser used for estuarine, shallow continental shelf work and instrument testing. Ship time is customarily available on a variety of research vessels. Cooperative projects are in progress with government agencies and universities in the United States and Mexico.

The Department of Geology has graduate studies in geology, geophysics, and geochemistry leading to the degrees of Master of Arts and Doctor of Philosophy. There is no single prescribed curriculum for all graduate students. Course programs are developed in line with a student's needs, interests and aims. Graduate work in geology is oriented toward the theoretical and fundamental aspects of the subject rather than directly toward its many applied aspects. All geology students are expected to have strong backgrounds in mathematics, physics and chemistry.

Graduate students at Rice may work on established projects or initiate their own if they are compatible with the equipment available and the interests of the staff. Approximately one-quarter of the thesis work in the department is related to oceanography.

Candidates for advanced degrees in geology are expected to: pass a reading exam in one foreign language (usually german, french or russian) for the doctorate. (no language is required for the master's degree); complete at a high level an approved program in geology and related subjects; pass during first year of residence a basic examination in geology, at a later date a Ph. D. qualifying examination is required of all doctoral candidates, and is administered by the thesis committee; complete for publication a thesis which represents an original contribution to the science; defend orally the research work and conclusions of the thesis, and engage in some laboratory instruction, regardless of type of appointment.

The following courses are offered in conjunction with the above programs:

Geo 332b	Sedimentation	4
Geo 342b	Oceanography	4
Geo 401a	Stratigraphy and Advanced Historical Geology	4
Geo 402b	Invertebrate Paleontology	4
Geo 405a	Micropaleontology	4
Geo 417a	Marine Geology	4
Geo 441a	Introduction to Geophysics	4

The instructional staff for the courses listed above consists of the following:

Casey, R. E., Ph. D.
Clark, H. C., Ph. D.
Warme, John E., Ph. D.
Wilson, James Lee, Ph. D.

To obtain further information, address all inquiries directly to:
Dr. J. Cl. De Bremaecker, Graduate Adviser
Department of Geology
Rice University
Houston, Texas 77001

UNIVERSITY OF RHODE ISLAND
Kingston, Rhode Island 02881

The Graduate School of Oceanography maintains a group of laboratories, offices and support facilities at the Narragansett Bay campus, a waterfront location in Naragansett, R. I. Principal structures are the Charles J. Fish Oceanographic Laboratory, the Francis H. Horn Laboratory, and the Claiborne Pell Marine Science Library, the latter two completed in 1968. The graduate school operates R/V Trident, a 180-foot research vessel, and a number of small craft.

The university offers the degrees of Master of Science in Oceanography and Doctor of Philosophy in Oceanography. Both degrees are given with options in biological, chemical, geological and physical oceanography.

The university also offers the Master of Marine Affairs (MMA). The Master of Marine Affairs Program is administratively within the Department of Geography and is supervised by an administering committee composed of the Provost of Marine Affairs, Dean of the Graduate School of Oceanography, Director of the Law of the Sea Institute, the chairman or his representative of the Departments of Ocean Engineering, Resources Economics, Geography, Geology and Political Science. Admission to the MMA Program normally requires a graduate degree and experience in marine related employment. The course of study is designed for persons interested in management and policy problems associated with marine activities.

The MMA Program is interdisciplinary; a one academic year non-thesis graduate program. All students study a core curriculum in marine geography, resource economics, oceanography, ocean engineering and international law.

Additional course work and/or supervised research in areas of the student's basic expertise is done among the graduate courses offered at the university in oceanography, ocean engineering, political science, geography and business administration. Integration of the course work for a meaningful appreciation of elements of management and decision-making in high seas and coastal zone marine resources is conducted in the Marine Affairs Seminar.

The following courses in the marine sciences are offered in conjunction with these programs. In addition, graduate students in oceanography may choose from supporting courses in other departments of the university.

401	General Oceanography	3
501	Physical Oceanography	3
510	Descriptive Physical Oceanography	3
521	Chemical Oceanography	3
540	Geological Oceanography	3
561	Biological Oceanography	3
567	Marine Bacteriology	3
568	Fishery Biology	3
571	Benthic Environment	3
574	Biology of Marine Mammals	2
599	Master's Research	
605	Dynamical Oceanography	3
611	Geophysical Hydrodynamics	3
612	Experimental Geophysical Hydrodynamics	3
613	Waves	3
614	Tides	1
621	The Estuary & Coastal Zone	3
623	Physical Chemistry of Sea Water	3
625	Organic Chemistry	3
630	Geochemistry	3
631	Seminar in Marine Chemistry	1
643	Seminar in Deep Sea Geology	3
644	Thermodynamics of the Earth's Interior	3
645	Geology of Continental Margins	3
647	Recent Sedimentary Environments	3
648	Marine Paleoecology	4
661	Phytoplankton Taxonomy	3
662	Ecological Concepts in Marine Research	3
663	Phytoplankton Physiology	3
664	Phytoplankton Ecology	4
666	Zooplankton	3
667	Advanced Phytoplankton Seminar	2
668	Advanced Phytoplankton Seminar	2
669	Advanced Phytoplankton Seminar	2
672	Marine Invertebrates & Environments	3
673	Advanced Animal Behavior	4
683	Quantitative Genetics I	3
684	Quantitative Genetics II	3
691	Individual Study	1-6
692	Individual Study	1-6
693	Special Studies	1-4
694	Special Studies	1-4
695	Seminar in Oceanography	1
699	Ph. D. Thesis Research	

Marine Affairs Core Program

GRADUATE

GEG 517	Marine Geography	3
FRE 514	Economics of Marine Resources	3
OCE 500	General Oceanography	3
OE 500	Basic Ocean Engineering	3
MAF 910.	International Law of the Sea	3
MAF 650	Marine Affairs Seminar	6

The instructional staff for the courses listed above consists of the following:

Dietz, Frank, Ph. D., Professor of Physics and Oceanography
deBoer, Jelle, Ph. D., Adjunct Professor
Diamantis, Basil, Ph. D., Assistant Professor
Duce, Robert A., Ph. D., Associate Professor
Jeffries, H. Perry, Ph. D., Associate Professor
Kennett, James, Ph. D., Associate Professor
Kenyon, Kern, Ph. D., Assistant Professor
Kester, Dana, Ph. D., Assistant Professor
Knauss, John A., Ph. D., Professor, Dean and Provost for Marine Affairs
Krause, Dale C., Ph. D., Associate Professor
Lambert, Richard, Ph. D., Assistant Professor
McMaster, Robert L., Ph. D., Professor
Napora, Theodore A., Ph. D., Assistant Professor and Assistant Dean for Students
Nixon, Scott, Ph. D., Assistant Professor
Phelps, Donald, Ph. D., Adjunct Professor
Pilson, Michael E., Ph. D., Assistant Professor
Pratt, David M., Ph. D., Professor
Quinn, James, Ph. D., Assistant Professor
Saila, Saul, Ph. D., Professor
Sastry, Akella N., Ph. D., Associate Professor
Schilling, Jean-Guy, Ph. D., Associate Professor
Shaw, David M., Ph. D., Adjunct Professor
Shuster, Carl H., Ph. D., Adjunct Professor
Sieburth, John McN., Ph. D., Professor
Smayda, Theodore J., Ph. D., Professor
Sprague, Lucien, Ph. D., Professor
Stern, Melvin, Ph. D., Professor
Sturges, Wilton, Ph. D., Associate Professor
Swift, Elijah, Ph. D., Assistant Professor
Watkins, Norman D., Ph. D., Professor
Winn, Howard E., Ph. D., Professor

MASTER OF MARINE AFFAIRS PROGRAM

GRADUATE SCHOOL OF OCEANOGRAPHY

Knauss, John A., Ph. D., Provost for Marine Affairs and Dean
Marshall, Nelson, Ph. D., Professor of Oceanography

DEPARTMENT OF OCEAN ENGINEERING

Middleton, Foster H., Dr. Eng., Chairman and Professor of Ocean Engineering
Sheets, Herman E., Dr. Eng., Professor of Ocean Engineering

DEPARTMENT OF GEOGRAPHY

Alexander, Lewis M., Ph. D., Chairman and Professor of Geography
Koers, Albert W., Visiting Professor of Marine Affairs

DEPARTMENT OF RESOURCES ECONOMICS

Lampe, Harlan C., Professor of Resources Economics
Rorholm, Niels, Ph. D., Professor of Resources Economics

DEPARTMENT OF GEOLOGY

Fisher, John J., Ph. D., Assistant Professor of Geology

To obtain further information, address all inquiries directly to:

Dr. John A. Knauss, Dean, Professor and Provost for Marine Affairs
University of Rhode Island
Kingston, Rhode Island 02881

The Department of Ocean Engineering operates two motor boats which are used for research in Narragansett Bay. The shore facilities and ship facilities of the Graduate School of Oceanography are available to ocean engineering faculty and graduate students. In addition, the College of Engineering laboratories include a well-equipped soils and sediments laboratory, an underwater acoustics laboratory in a new building, a sub-critical reactor, many wave and model tanks in the several engineering buildings. Nearby Navy and Industrial laboratories have made many of their facilities available for cooperative research work.

The following degrees are offered by the University:
Master of Science in Ocean Engineering.
Doctor of Philosophy in Ocean Engineering.

The following courses are offered in conjunction with the above programs:

OCE	434	Corrosion and Corrosion Control
OCE	457	Fluidics
OCE	512	Hydrodynamics of Floating and Submerged Bodies I
OCE	513	Hydrodynamics of Floating and Submerged Bodies II

OCE	531	Underwater Power Systems
OCE	532	Coastal Zone Power Plants
OCE	540	Environmental Control in Ocean Engineering
OCE	561	Introduction to the Analysis of Oceanographic Data
OCE	571	Underwater Acoustics I
OCE	587	Submarine Soil Mechanics
OCE	591	Special Problems - Ocean Engineering Analysis
OCE	591A	Special Problems - Ocean Instrumentation
OCE	592A	Advanced Corrosion Engineering
OCE	605	Ocean Engineering Seminar
OCE	606	Ocean Engineering Seminar
OCE	610	Engineering Ocean Mechanics
OCE	622	Analysis of Oceanographic Data Systems
OCE	653	Ocean Engineering Systems Studies
OCE	654	Ocean Engineering Systems Studies
OCE	672	Underwater Acoustic Propagation I
OCE	691	Special Problems

The instructional staff for the courses listed above consists of the following:

Brown, G. A., Sc. D., Professor
Haas, R. B., M. S., Associate Professor
Kowalski, T., Ph. D., Associate Professor
Middleton, F. H., Dr. Eng., Chairman and Professor
Moffett, M. B., Ph. D., Assistant Professor
Nacci, V. A., M. S., Professor
Rose, V. C., Ph. D., Associate Professor
Schenck, H. Van N., Jr., M. S., Professor
Sheets, H. E., Sc. D., Professor
Soltz, G. C., Ph. D., Assistant Professor
Stanislao, J., M. S., Associate Professor
White, F. M., Jr., Ph. D., Professor

To obtain further information, address all inquiries directly to:

F. H. Middleton, Chairman
Ocean Engineering Department
College of Engineering
University of Rhode Island
Kingston, Rhode Island 02881

The Department of Fisheries and Marine Technology operates facilities both on and off the main campus at Kingston. Main operations are conducted from Wickford on Narragansett Bay where the training vessels are berthed. The facilities contain practical laboratories for the training in seamanship, fishing gear, navigation, electronic aids (to navigation and fisheries), engineering and electrical technology. Two training vessels are available; the 47-foot Gail Ann, specifically converted for fisheries training and completely equipped, with a Decca Navigator and Sonar, and capable of working all common fishing methods; and a 21-foot Romany Fisherman for in-shore training.

The Department offers the degree of Associate in Science (Commercial Fisheries). In order to obtain the degree, all students are required to complete 72 credits over a two-year period--51 in fisheries and marine technology, 21 in general education; business and economics.

The following courses are offered by the department in conjunction with the above program:

013	Shipboard Work I	1
014	Shipboard Work II	1
015	Shipboard Work III	1
118	Introduction to Commercial Fisheries	4
121	Fishing Gear I	3
122	Fishing Gear II	3
131	Seamanship	3
135	Fisheries Meteorology	1
141	Marine Engineering Technology I	4
142	Marine Engineering Technology II	4
151	Fish Technology	4
161	Marine Electronics	3
171	Vessel Technology	3
181	Navigation I	4
182	Navigation II	3
192	Fishing Operations	4

The instructional staff for the courses listed above consists of the following:

Hillier, Albert, Assistant Professor of Fisheries and Marine Technology
McCauley, James A., B. S., Assistant Professor of Fisheries and Marine Technology
Meade, Thomas L., Ph. D., Associate Professor of Fisheries and Marine Technology
Merriam, Robert, M. S., Assistant Professor of Fisheries and Marine Technology
Motte, Geoffrey A., Assistant Professor of Fisheries and Marine Technology
Sainsbury, John C., Ph. D., Chairman and Associate Professor of Fisheries and Marine Technology

To obtain further information, address all inquiries directly to:

Dr. J. C. Sainsbury, Chairman
Department of Fisheries & Marine Technology
210 Woodward Hall
University of Rhode Island
Kingston, Rhode Island 02881

ROGER WILLIAMS COLLEGE
Bristol, Rhode Island 02809

Roger Williams College's main campus is in Bristol, Rhode Island, with approximately 800 feet of shoreline on Mount Hope Bay, a portion of Narragansett Bay. A wide variety of marine environments are within ten miles of the campus, including water depths of more than 150 feet, rocky ocean shorelines, tidal marshes, estuaries with a wide variety of salinities, and a wide variety of bottom types. Waters near the campus range from those with concentrations of industrial and human waste to relatively pollution-free ocean waters. Small classes of six to 15 students in upper level courses make field work, laboratory work and special projects an important part of the curriculum. A paper or other evidence of the student's ability to conduct investigations, use library resources and write a report is usually required in each upper level course.

Physical facilities used by students taking courses related to marine science include six laboratories, one preparation room, one instrument and storage room, a dark room, an audio-tutorial laboratory and numerous classrooms and lecture halls, a library, dining hall and dormitories. Staff members include Scuba divers and a licensed boat captain who operates under charter for the college a 41-foot twin-diesel sport-fisherman or a 37-foot twin-gas express cruiser. Equipment includes various mesh size plankton nets, seines, spectrophotometers, microscopes including binocular phase types, water sampling equipment, three small refrigerated seawater tanks, photographic equipment, a flame photometer, refrigerated centrifuge, electrophoresis and chromatography equipment, pH meters, environmental chambers and a gas chromatograph.

Among the degrees offered by the institution is the B. A. in Biology with an opportunity to concentrate in marine sciences. In addition to the all college core requirements, a student receiving this degree would complete two semesters of introductory biology, six upper level courses in

biology, two semesters of general chemistry, two semesters of organic chemistry, two semesters of physics and a one-credit biology seminar and a one-credit biology communications course.

There were ten recipients of the B.A. degree in biology in the one graduating class since accreditation as a four-year undergraduate institution in May 1972.

The following courses are offered supporting the marine science program:

Bio 220	Marine Zoology	4
Bio 240	Concepts of Ecology	4
Bio 320	Marine Ecology	4
Bio 335	Invertebrate Zoology	4
Bio 345	Experimental Marine Developmental Biology	4
Bio 355	Marine Phycology	4
Bio 360	Estuarine Ecology	4
Bio 499	Biology Independent Study	1-4
PhySci 410	Meteorology	2
Chem 101, 102	Environmental Chemistry (2 semesters)	8
NatSci 220	Principles of Oceanography	4

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Holstein, Thomas Jr., Ph.D.
Mershon, William R., MAT, LCDR, USN (Ret.)
Villalard-Bohnsack, Martine, Ph.D.

PHYSICAL SCIENCE

Hawkins, David G., M.S.
Hetzler, Charles, Ph.D.
Payson, Harold, M.S., Capt. USN (Ret.)

CHEMISTRY

Munger, James I., M.S.
Von Riesen, Daniel, Ph.D.

To obtain further information, address all inquiries directly to:

Mr. William R. Mershon
Biology Area Coordinator
Roger Williams College
Bristol, Rhode Island 02809
(401) 255-2226

RUTGERS - THE STATE UNIVERSITY OF NEW JERSEY
New Brunswick, New Jersey 08903
Camden, New Jersey
Newark, New Jersey

Modern laboratory facilities in the basic sciences are available on the three city campuses. In addition, the university operates several small laboratories on the New Jersey coast involved with various aspects of shellfish research and an impending larger laboratory on Great Bay which is being designed to work on the full range of marine inquiry. A 65-foot research vessel was recently acquired and will work out of the Great Bay station. A 40-foot research vessel, based at one of the laboratories on Delaware Bay, operates year-round, providing facilities for power dredging and hydrographic sampling within the estuary. A small fleet of outboards is available for a variety of studies in the coastal bays and sounds, throughout the length of the state. An ancient houseboat laboratory is another base for summer work in one of the estuaries. The research programs underway in these laboratories provide coastal marine experiences for approximately 25 students annually.

Undergraduate students planning to do advanced work in the marine sciences usually major in one of several undergraduate degree programs such as biology, geology, environmental science, and chemistry. In addition to satisfying requirements for their major, these students may elect one or more undergraduate courses from the list below.

At the graduate level, no degree program is specifically labeled "marine," but graduate students in Ph.D. programs in zoology, botany, environmental science, ecology, microbiology and geology can gain marine experience in the coastal research programs underway here.

A new Ph.D. program in Geophysical Fluid Dynamics is now offered through the cooperative efforts of the Department of Mechanical and Aerospace Engineering and the Department of Meteorology. Teaching and research concentrate on fluid dynamics problems of the geosphere, i.e., on meteorological and oceanographic fluid dynamics and related problems. The program draws on research and graduate courses in the fields of meteorology, engineering, mathematics, information sciences and others as necessary. Specializations available within the program include meteorology, oceanography, upper atmosphere dynamics, air pollution, turbulence, turbulent dispersion, and rotating and stratified flow.

Rutgers has recently established the Marine Sciences Center as a research arm of the university. The center will interact with the variety of departments on campus, but will not develop its own curriculum at this time. Rather, faculty and students will work through the Marine Sciences Center while retaining their affiliation with their academic departments.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

AGRICULTURAL ENGINEERING

381 Introduction to Environmental Systems Analysis
382 Techniques of Environmental Systems Analysis

BACTERIOLOGY

432 Applied Bacteriology

BIOLOGY

212 The Ecology of Marine Life
351 General Ecology
415 Marine Ecology

BOTANY

411 Algae: Morphology and Taxonomy

CHEMICAL AND BIOCHEMICAL ENGINEERING

303 Transport Phenomena
304 Transport Phenomena

ENVIRONMENTAL SCIENCE

403 Introduction to Air and Water Environment
404 Aquatic Biology
444 Water Resources - Water Quality

FOOD SCIENCE

103 Man and His Food

GEOGRAPHY

407 Remote Sensing of Earth Resources
410 Ocean Trade and Transportation
417 Coastal Geomorphology

GEOLOGY

331 Oceanology
340 Sedimentology
451 Geology of Ocean Basins
453 Paleoecology

MECHANICAL AND AEROSPACE ENGINEERING

351 Thermodynamics

METEOROLOGY

301 Elements of Meteorology
417 Synoptic Meteorology
418 Synoptic Meteorology
421 Dynamic Meteorology
422 Dynamic Meteorology
432 Physical Oceanography

MICROBIOLOGY

496 Microbial Ecology

PHYSIOLOGY

306 Comparative Animal Physiology

ZOOLOGY

406 Limnology

GRADUATE

ANIMAL SCIENCES

541 Biological Aspects of Stress

BIOCHEMISTRY

511 Plant Biochemistry

BOTANY

507 Plant Geography
513 The Algae: Biology and Physiology
589 Ecosystem and Community Dynamics

CHEMICAL AND BIOCHEMICAL ENGINEERING

502 Fluid Momentum and Energy
533 Advanced Chemical Engineering Thermodynamics
534 Advanced Chemical Engineering Thermodynamics
587 Applied Kinetics and Thermodynamics for Enzymatic Processes
581 Biochemical Engineering

CIVIL ENGINEERING

563 Advanced Hydrology
573 Advanced Soil Mechanics
583 Hydromechanics
578 Soil Dynamics
588 Theory of Hydraulic Models
590 Coastal Engineering

ENVIRONMENTAL SCIENCE

501 Waste Treatment I: Sewage Treatment
502 Stream Sanitation
503 Environmental Chemistry and Analysis
507 Principles of Aquatic Chemistry
511 Ichthyology
512 Ichthyology and Fishery Management
514 Application of Aquatic Chemistry
517 Principles of Environmental Science
518 Principles of Environmental Science

FOOD SCIENCE

513 Advanced Food Science

GEOGRAPHY

501 Natural Resource Management
509 Problems in Port Geography

GEOLOGY

514 Advanced Sedimentary Petrology
526 Planktonic Foraminifera
553 Micropaleontology: Foraminifera
554 Micropaleontology: Foraminifera
570 Marine Geology

GEOPHYSICAL FLUID DYNAMICS

501 Fluid Dynamics of the Atmosphere
611 Seminar in Geophysical Fluid Dynamics

MECHANICAL AND AEROSPACE ENGINEERING

515 Fluid Dynamics
516 Fluid Dynamics
517 Heat and Mass Transfer
518 Heat and Mass Transfer
539 Mechanics of Real Fluids
621 Theory of Turbulence
622 Atmospheric Turbulence

METEOROLOGY

501 Micrometeorology
508 Dynamic Climatology

MICROBIOLOGY

501 General Microbiology
502 General Microbiology

PHYSIOLOGY

507 Comparative Physiology
531 Advanced Nerve and Muscle Physiology

PLANT PHYSIOLOGY

505 Plant Physiology
506 Plant Physiology

ZOOLOGY

504 Elements of Oceanography
505 Malacology
506 Ecology of the Estuary
507 Immunity to Animal Parasites
590 Population Ecology

The instructional staff for the courses listed above includes the following:

AGRICULTURAL ADMINISTRATION

Locandro, Roger, Research

AGRICULTURAL CHEMISTRY

Helrich, Kenneth, Research Professor
Rosen, Joseph D., Ph.D., Associate Research Professor
Winnett, George, Ph.D., Professor

ANATOMY

Hess, Arthur, Ph.D., Professor
Schmidt, Elaine, Ph.D., Instructor

ANIMAL SCIENCE

Hackett, A.J., Ph.D., Assistant Professor
Kingsbury, Frank W., Ph.D., Extension Veterinarian
McGrath, James J., Ph.D., Associate Professor

BACTERIOLOGY

Koft, Bernard W., Ph.D., Professor
Litchfield, Carol, Ph.D., Assistant Professor
Umbreit, W., Ph.D., Professor

BIOCHEMISTRY AND MICROBIOLOGY

Bartha, Richard, Ph.D., Assistant Research Professor
Litchfield, Carter, Ph.D., Associate Professor
Pramer, David, Ph.D., Professor
Price, C.A., Ph.D., Professor

BIOLOGY

Jenkins, Robert, Ph.D., Research Professor
Lee, Hsin-Yi, M.S., Assistant Professor

BIOLOGICAL RESEARCH

Squibb, Robert L., Ph.D., Professor

BOTANY

Chen, James C.W., Ph.D., Associate Professor
Edwards, Peter, Ph.D., Assistant Professor
Good, Ralph E., Ph.D., Associate Professor
Maul, Edwin T., Ph.D., Professor
Quinn, James A., Ph.D., Associate Professor

CHEMICAL AND BIOCHEMICAL ENGINEERING

Ahlert, Robert C., Ph.D., Professor
Davidson, Burton, Ph.D., Professor
Dittman, Frank W., Ph.D., Professor
Vieth, Wolf., Ph.D., Professor

CIVIL ENGINEERING

Bourodimos, E.L., Ph.D., Associate Professor
Chae, Yong S., Ph.D., Professor

ELECTRICAL ENGINEERING

Rosenthal, Louis A., M.E.E., Professor

ENTOMOLOGY

Hansens, Elton J., Ph.D., Research Professor
Jobbins, Daniel M., M.S., Research Specialist
Ward, Diana, Ph.D., Assistant Research Professor

ENVIRONMENTAL RESOURCES

Mitchell, J. Kenneth, M.A., Lecturer
Niswand, George H., Ph.D., Assistant Professor
Westman, James R., Ph.D., Professor
Whipple, William, Jr., C.E.

ENVIRONMENTAL SCIENCE

Faust, Samuel D., Ph.D., Research Professor

FOOD SCIENCE

Chang, Stephen S., Ph.D., Professor
Haard, Norman F., Ph.D., Assistant Professor
Hayakawa, Kan-Ichi, Ph.D., Associate Professor
Maclinn, Water A., Ph.D., Professor
Morse, Roy C., Ph.D., Professor
Solberg, Myron, Ph.D., Professor

GEOGRAPHY

Psuty, Norbert P., Ph.D., Associate Professor

GEOLOGY

Hirsch, Alfred M., Ph.D., Assistant Professor
Lodding, William L., M.S., Associate Research Specialist
Murray, Raymond C., Ph.D., Professor
Osson, Richard K., Ph.D., Professor
Piburn, Michael, Ph.D., Assistant Professor
Wiles, William W., Ph.D., Associate Professor
Younce, Gordon B., Ph.D., Assistant Professor

MARINE EXTENSION - PUBLIC RELATIONS

Isbit, Arthur, Ph.D.

MECHANICAL AND AEROSPACE ENGINEERING

Chen, Chuan F., Ph.D., Professor

MECHANICS AND MATERIALS ENGINEERING

Sauer, J. A., Ph.D., Professor

METEOROLOGY

Havens, A. Vaughn, M.S., Professor

MICROBIOLOGY

Gordon, Ruth E., Ph.D., Professor
Lechevalier, H.A., Ph.D., Professor

PATHOLOGY

McCoy, John R., Ph.D., Professor

PHARMACEUTICAL SCIENCE

Babcock, P.A., Ph.D., Associate Professor

PSYCHOLOGY

Ward, Lawrence M., Ph.D., Assistant Professor

PHYSIOLOGY

Bird, John W.C., Ph.D., Professor
Farmanfarmaian, A., Ph.D., Professor
Senft, Joseph P., Ph.D., Associate Professor

PLANT PATHOLOGY

Halisky, Philip M., Ph.D., Associate Professor

PLANT SCIENCE

Dawson, Ray F., Ph.D., Professor
Karmas, Endel, Ph.D., Assistant Professor

SOILS AND CROPS

Battle, Warren R., Ph.D., Professor
Duell, Robert W., Ph.D., Associate Research Professor
Tedrow, John C.F., Ph.D., Professor
Toth, Stephen J., Ph.D., Professor

STATISTICS

Andrews, Horace P., Ph.D., Associate Professor

ZOOLOGY

Durand, James B., Ph. D., Professor
Gardiner, Lion F., Ph. D., Assistant Professor
Haskin, Harold, Ph. D., Professor
Hastings, Robert, Ph. D., Assistant Professor
Leck, Charles F., Ph. D., Assistant Professor
Loveland, Robert E., Ph. D., Associate Professor
Pearson, Paul G., Ph. D., Professor
Trama, Francesco B., Ph. D., Professor
Weis, Judith S., Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Norbert P. Psuty, director
Marine Sciences Center
Rutgers - The State University of New Jersey
New Brunswick, New Jersey 08903

RUTGERS UNIVERSITY
COOK COLLEGE
New Brunswick, New Jersey 08903

Cook College will offer the marine science program formerly offered in the College of Agriculture and Environmental Science at Rutgers University. The four-year undergraduate program will provide a broad, in-depth study of sciences in preparation for graduate study in the well-defined areas of marine biology, oceanography and marine geology. Students will work closely with a series of advisers who possess marine science expertise. Ample classroom and laboratory facilities will be available at Cook College. Facilities at the Department of the Interior Marine Science Laboratory at Sandy Hook, New Jersey, are also utilized.

The terminal degree offered in the undergraduate program is a Bachelor of Science. A total of 134 credits are required for graduation. M. S. and Ph. D. programs are also available through the graduate school. Students enrolled in the marine science program generally take up to 100 credits in science. The basic core requirements are chemistry, mathematics, biology and physics.

The following courses are offered in conjunction with the above program:

Energy Conversion for Biological Systems
Environmental Systems Analysis for Engineers
Microbial Ecology
Environmental Physiology
Introduction to Environmental Systems Analysis
Living Aquatic Resources
Elements of Water and Wastewater Treatment
Introduction to Air and Water Environment
Fundamentals of Water and Wastewater
Environmental Physics
Radioactivity and the Environment
Water Resources - Water Quality
Elements of Meteorology
Physical Oceanography

The instructional staff for the courses listed above consists of the following:

Bartha, Richard, Ph. D.
Faust, Samuel D., Ph. D.
Finstein, Melvin S., Ph. D.
Hunter, Joseph V., Ph. D.
Katz, Stanley E., Ph. D.
Stout, Benjamin B., Ph. D.
Walton, Grant F., M. S.
Westman, James R., Ph. D.

To obtain further information, address all inquiries directly to:

Roger R. Locandro, Assistant Director of Resident Instruction and Marine Science Adviser
College of Agriculture and Environmental Science
P. O. Box 231, Rutgers University
New Brunswick, New Jersey 08903
(201) 247-1766

ST. JOHN'S UNIVERSITY
Jamaica, New York

The university offers marine science courses at the Jamaica campus and encourages advanced students to undertake field work at the New York Ocean Science Laboratory, Montauk, New York. The science building on the Jamaica campus opened in 1958. The departments of biology, chemistry and physics and the College of Pharmacy are located in this building which contains complete laboratory and classroom facilities for instruction and research. The marine waters of Long Island Sound, Jamaica Bay, Great South Bay and the Atlantic Ocean are easily accessible for collecting samples and specimens. The biology department has arranged for the use of facilities at the New York Ocean Science Laboratory where research vessels and specialized equipment are available.

The following are degrees offered:

1. Ph. D. in Marine Biology (Department of Biology) All students are required to do research in some aspect of marine biology and must pass a written comprehensive examination in their field of study. An oral examination is also given on the subject matter of the doctoral dissertation. The course requirements are determined by a special faculty committee on the basis of the professional objectives of the individual student. A minimum of 69 semester hours of graduate course work beyond the bachelor's degree or a minimum of 36 semester hours beyond the Master's degree must be taken in the program. The student must also demonstrate an ability to read two of the following languages: french, german and russian.

2. M. S. in Marine Biology (Department of Biology) All students take a special research course in some aspect of marine biology and must pass a comprehensive examination in their field of study. A minimum of 33 semester hours of graduate courses beyond the bachelor's degree must be taken in the program. At present there is no formal dissertation or language requirement for this degree.

3. B. S. in Biology (with special emphasis on Marine Biology) This is the regular program for biology majors who may elect to take some courses and research in marine biology and related subjects.

UNDERGRADUATE COURSES

23	Invertebrate Zoology	4
33	Marine Biology	4
37	Ecology	2
38	Biological Techniques	2
40;41	Research in Biology	4
42	Biology of Selected Protists	4

GRADUATE COURSES

205;206	Microbial Physiology	6
209	Protozoology	3
226	Marine Microbiology	3

246;247	Marine & Fresh Water Invertebrates	6
249;250	Marine Environmental Biology	6
255;256	Ecology of Biotic Communities	6
352;353; 354; 355	Special Research in Biological Sciences	12
406;401	Seminar in Experimental Zoology	6
450;451	Dissertation Research	6
452;453	Dissertation Research	6

(Other graduate courses in microbiology, biochemistry and physiology are available to complete the specialized programs of individual students.) Graduate courses and research taken at New York Ocean Science Laboratory, Montauk, New York or at Marine Biological Laboratory, Woods Hole, Massachusetts or at other recognized marine laboratories will be accepted for credit.

The instructional staff for the courses listed above consists of the following:

Department of Biology:

Concannon, Joseph N., Ph. D., Associate Professor
D'Agostino, Anthony S., Ph. D., Associate Professor
Efthymiou, Constantine, Ph. D., Associate Professor
Frascella, Daniel W., Ph. D., Assistant Professor
Jack, R. Cecil M., Ph. D., Associate Professor
Liberti, Alfred V., Ph. D., Chairman and Professor of Biology
Lilly, Daniel M., Ph. D., Professor
Pisano, Michael A., Ph. D., Professor
Rio, Guido J., Ph. D., Assistant Professor
Stalter, Richard, Assistant Professor

To obtain further information, address all inquiries directly to:

Professor Daniel M. Lilly
Department of Biology
St. John's University
Grand Central and Utopia Parkways
Jamaica, New York 11432

SAN DIEGO COMMUNITY COLLEGES
City College, San Diego, California 92101
Mesa College, San Diego, California 92112
Evening College, San Diego, California 92101

These colleges each offer a two-year program leading to either an associate science degree or certificate in marine technology. Shop facilities are utilized for practical instruction in refrigeration, welding, propulsion machinery, drafting and other allied industrial arts that have relevance to marine work. Biological, physical and chemical laboratories are used for class work needed to develop skills related to basic tasks needed in the marine environment. Initially, instruction began in 1967 and the full program began in 1969. A wide range of marine science, ocean engineering and business enterprises are carried on in San Diego, and many of these are frequently visited in the course of field trips. Vessels are chartered for all-day at-sea instruction. A shoreside technology institute jointly administered by a countywide alliance of higher education institutions is to be designed in 1974.

The following courses are offered in conjunction with the above programs:

MARINE TECHNOLOGY

1	Introduction to Marine Technology	3
2	Marine Technology Laboratory	3
3	Marine Industrial Operations	3
4	Marine Construction.	3
5	Equipment Operations	3
6	Marine Resources	3
7	Marine Communications	3
8	Seamanship and Engineering	3

The instructional staff for the courses listed above includes the following:

Eberhardt, Robert L., M.S., Instructor in Marine Technology

To obtain further information, address all inquiries directly to:

William Steinberg
Director of Vocation Education
San Diego Community Colleges
835 Twelfth Avenue
San Diego, California 92101

SANTA BARBARA CITY COLLEGE
Santa Barbara, California 93109

Courses within the marine technology curriculum are offered either on the main college campus overlooking Santa Barbara harbor or at the nearby Trade and Industrial Center. The Geology and Life Science building was completed in the spring of 1970 and includes modern laboratory facilities for physical oceanography, biological oceanography, and marine biology. The Physical Science building completed in 1965 houses modern laboratory facilities for technical physics and chemistry. The Trade and Industrial Center, opened in the fall of 1968, includes facilities for machine shop, welding, marine engines and compressors, drawing and blueprint reading, rigging and diver training. The diver training facility includes two 12-foot by 12-foot diving training tanks with overhead monorail systems for placing heavy equipment in the tanks for various diving exercises. The diving facility houses modern and advanced commercial diving equipment, including a diving bell, double-lock deck decompression chamber, mixed gas equipment, diver life support equipment, underwater welding and cutting and pneumatic and hydraulic equipment and tools, and the deep submersible Dowb. Extensive offshore training is conducted from local work boats and research vessels that are loaned or rented from private industry. Diver training includes ocean bell dives and mixed gas dives to depths of 200 feet.

An Associate in Science in Marine Diving Technology is offered by the college. All students are obligated to complete all required course work as scheduled. In addition to the courses which follow, students wishing to qualify for an Associate in Science degree must satisfy local and state requirements consisting of three units of American Institutions and two units of Health Education. A student not completing these requirements, but fulfilling all others, is eligible for a Certificate of Completion in Marine Diving Technology. Twenty-five students completed the program in June 1972.

The following courses are offered in conjunction with the above program:

MARINE TECHNOLOGY

1	Seamanship and Small Boat Handling	3
2	Basic Diving (Scuba and Hookah)	3
3	Advanced Diving	3
4	Fundamentals of Marine Engines and Compressors Compressors	3

5	Underwater Construction	3
6	Underwater Operations	3
7	Diving Systems	3
11	Summer Work Experience	1-4
21	Research Module (Indepondent Work Study)	1-3
22	Research Module (Independent Work Study)	1-3

INDUSTRIAL TECHNOLOGY

2	Drawing and Blueprint Reading	3

MACHINE SHOP AND WELDING

11	Machine Shop Operations	4
1	Welding	2
3	Welding (Marine)	2

ELECTRONICS

10	Fundamentals of Electronics	3

ENGLISH

18A	Technical Report Writing	1.5
18B	Technical Report Writing	1.5

FINE ARTS

5	Business Speech	3

LIFE SCIENCE

5	Marine Biology	3
11	Biological Oceanography	3

CHEMISTRY

1	Introductory Chemistry	4

EARTH SCIENCE

11	Physical Oceanography	4

PHYSICAL SCIENCE

11	Technical Physics	4
12	Technical Physics	4

MATHEMATICS

41	Technical Algebra	3
43	Technical Trigonometry	3

The instructional staff for the courses listed above consists of the following:

VOCATIONAL TECHNICAL DIVISION

Christensen, Robert W., Assistant Professor
Parker, Jim G., Assistant Professor
Parks, H. Ramsey, Coordinator and Assistant Professor
Soule, Edwin A., Instructor
Tlapa, Richard F., Associate Professor

ENGLISH DIVISION

Foxx, James E., Associate Professor

FINE ARTS DIVISION

Crawford, Barbara T., Instructor

LIFE SCIENCE DIVISION

Jorgensen, William C., Assistant Professor

PHYSICAL SCIENCE AND ENGINEERING DIVISION

Olsen, Phil G., Assistant Professor
Miller, William E., Associate Professor

To obtain further information, address all inquiries directly to:

Ramsey Parks
Coordinator - Assistant Professor, Marine Technology
Santa Barbara City College
721 Cliff Drive
Santa Barbara, California 93109
(805) 962-7519

SEATTLE CENTRAL COMMUNITY COLLEGE
Seattle, Washington 98122

The college offers marine engineering technology courses at its ship canal campus in central Seattle. This two-acre site has its own shore support classrooms and engineering laboratories, as well as the necessary deep-water piers for docking the training vessel. "Hands-on" time is emphasized aboard the 189-foot, 1,268-ton training ship, S/S Trident. Students become directly invovled in the operation, maintenance, and inspection of marine systems aboard the training ship.

Associate Degree, Marine Engineering Technology. This program emphasizes the practical training necessary for the efficient operation and effective maintenance of sea-going vessels. As a rule, students find employment aboard fisheries vessels, ocean-going tugs and ferries operating in the Pacific Northwest. Throughout the entire two years of coursework, laboratory experiments plus shipboard operations and maintenance accompany all theoretical studies. The program is designed to provide extensive and diversified training from the start.

The following courses are offered in conjunction with the above program:

MTE	101	Engine Department Maintenance	4
MTE	102	Auxiliary Machinery	4
MTE	103	Auxiliary Machinery	4
MTE	106	Ship's Shop Practice	2
MTE	111	Marine Electricity	4
MTE	112	Marine Electricity	4
MTE	113	Marine Electricity	4
MTE	122	Marine Hydraulics	3
MTE	123	Marine Hydraulics	3
MTE	131	Boilers	2
MTE	132	Boilers	2
MTE	140	Maritime Law	3
MTE	141	Maritime Economics	3
MTE	142	Labor Relations	3
MTE	145	Survival at Sea	4
MTE	146	Deck Department Maintenance	4
MTE	147	Deck Department Maintenance	3
MTE	148	Ship's Medical Practice	2
MTE	152	Piloting and Chart Navigation	4
MTE	153	Piloting and Chart Navigation	4
MTE	171	Diesel Engines	3
MTE	181	Basic Marine Refrigeration	3
MTE	241	Welding	3
MTE	242	Welding	3
MTE	251	Turbine Engines	3
MTE	253	Propulsion Engines	3
MTE	254	Propulsion Engines	3
MTE	271	Diesel Engines	4
MTE	272	Diesel Engines	3
MTE	281	Marine Refrigeration Systems	4
MTE	290	Coast Guard Rules and Regulations	3

MTE	293	Instrumentation	3
MTE	299	Engineering Graphics and Blueprint Reading	3

The instructional staff for the courses listed above includes the following:

Campion, Robert, Instructor
Dahlgren, H. Kenneth, Instructor, Marine Engineering Technology
Klones, Daryl, Instructor
Rambeau, Morris, U.S.C.G. Licensed Marine Engineer
Smith, Donald W., Department Chairman, Marine Engineering Technology: M.S.; U.S.C.G. Licensed Marine Engineer
Zandee, Peter M., Instructor

To obtain further information, address all inquiries directly to:

Registrar
Seattle Central Community College
1718 Broadway
Seattle, Washington 98122

SEATTLE PACIFIC COLLEGE
Seattle, Washington 98119

The college offers marine biology courses at its main campus in Seattle, Casey Campus in Whidbey Island and at other facilities such as Friday Harbor. The Casey Campus encompasses more than 100 acres of wooded hills, fields and private beach. Local accommodations include barracks, kitchen and dining facilities, gymnasium, auditorium, classrooms, outside basketball courts, track and field facilities and a swimming pool.

Marine biology facilities include a running seawater wet laboratory and a classroom building which houses three laboratories, a lecture room, office and library. A full program of summer study in marine biology is provided. The facility is used extensively by public schools in conservation and nature study programs in the spring and fall.

The B.S. in Biology is offered by the college. All students are required to take General Biology 201 and 202 or the equivalent, Biology 301 (Microbiology), Biology 310 (Ecology), Biology 320 (Developmental Biology), Biology 371 (Genetics) and 25 additional quarter hours in upper division biology, plus departmental seminar. Chemistry through organic is required.

The following additional courses are offered in conjunction with the above program:

BIOLOGY

400	Marine Problems	1-5
432	Marine Invertebrate Biology	5
444	Marine Botany	5
450	Environmental Physiology	5
498	Biological Research	1-3

The instructional staff for the courses listed above consists of the following:

Bruce, David S., Ph.D., Environmental Physiology
Phillips, Ronald, Ph.D., Marine Botany and Ecology
Shaw, Ross F., Ph.D., Invertebrate Biology and director of Casey Campus

To obtain further information, address all inquiries directly to:

Dr. Ross Shaw
Director of Marine Biology Program
Seattle Pacific College
Seattle, Washington 98119

SHORELINE COMMUNITY COLLEGE
Seattle, Washington 98133

Shoreline Community College offers two-year marine science technology programs, oceanography, technology and marine biology technology. Special facilities for shops, welding, applied chemical instrumentation and oceanography have recently been added, and a 6 1/2 acre site on Puget Sound where a regional marine lab facility is in the planning stages is available. The college owns a small boat outfitted for fieldwork, such as trawling, dredging, coring, water sampling and navigation training.

The college offers an Associate of Applied Arts and Sciences degree in Oceanography Technology and Marine Biology Technology. Requirements for admissions are high school graduation or 18 years of age, and a personal interview before acceptance into the program.

The following courses are offered in connection with the above programs:

OCEANOGRAPHY TECHNOLOGY

Bio	103	Marine Biology	5
Chem	101	General Chemistry	5
Chem Tech	190	Gravimetric and Volumetric Methods	5
Chem Tech	191	Electroanalytical Methods	6
Chem Tech	192	Optical and Chromotographic Methods	6
Elec Engr Tech (EET)	140	Electronics for Technicians	4
EET	141	Electronics for Technicians	4
Engr Tech	150	Technical Drawing I	5
Engr Tech	155	Elementary Surveying	5
Indus Tech	102	Machine Tool Fundamentals	4
Indus Tech	103	Machine Tool Practices	4
Indus Tech	115	Welding and Foundry Fundamentals	4
Indus Tech	116	Plastic Shop	4
Indus Tech	160	Small Engines	4
Math	40	Elementary Algebra	5
Math	101	Intermediate Algebra	5
Math	191	Technical Mathematics	4
Math	192	Technical Mathematics	4
Math	116/200	Survey of the Computer/Intro to Computer	2
Ocean	101	Survey of Oceanography	5
Ocean Tech	174	Underwater Photography	1
Ocean Tech	196	Oceanographic Instrumentation Techniques	6
Ocean Tech	197	Ocean Instrumentation Techniques	6

MARINE BIOLOGY TECHNOLOGY

Bio	101	Principles of Biology	5
Bio	103	Marine Biology	5
Bio	201	Topics in Microbiology	5
Bio Tech	195	Biological Techniques	5
Chem	101	Basic Chemistry	5
Chem Tech	190	Gravimetric and Volumetric Methods	6
Chem Tech	191	Electroanalytical Methods	6
Chem Tech	192	Optical and Chromotographic Methods	6
EET	140	Electronics for Technicians	4

EET	141	Electronics for Technicians	4
Indus Tech	102	Machine Tool Fundamentals	4
Indus Tech	103	Machine Tool Practices	4
Indus Tech	116	Plastic Shop	4
Indus Tech	160	Small Engines	4
Math	40	Elementary Algebra	5
Math	101	Intermediate Algebra	5
Math	191	Technical Mathematics	4
Math	192	Technical Mathematics	4
Math	116/200	Survey of the Computer/Intro to Computer	2
Ocean	101	Survey of Oceanography	5
Ocean Tech	196	Oceanographic Instrumentation Techniques	6
Ocean Tech	197	Oceanographic Instrumentation	6
Photo	100	General Photography	3
Zoo	111	General Zoology	5
Zoo	112	General Zoology	5

Shoreline graduates about 20 persons per year which represents about 30 percent of those who initially entered the programs. We will be limiting the number of incoming students to 30 in each program.

OCEANOGRAPHY TECHNOLOGY

PE	140	Beginning Scuba Diving	1
PE	240	Advanced Scuba Diving I	2
PE	241	Advanced Scuba Diving II	2
Photo	100	General Photography	3

UNIVERSITY OF SOUTH CAROLINA
Columbia, South Carolina 29208

Facilities for laboratory research are available on the campus in the Departments of Biology and Geology, the Belle W. Baruch Coastal Research Institute and the Electron Microscope Laboratory. These facilities include equipment for molecular studies as well as organismic and field studies. In addition, the costal region offers not only natural environments relatively uncontaminated by man's activities but also environments unique to the eastern United States. The Baruch Plantation near Georgetown, South Carolina, a 17,000 acre tract bordering Winyah Bay, North Inlet, and the Atlantic Ocean offers a natural setting for field investigations. The Santee Delta, the only delta impinging directly on the Atlantic Ocean, Winyah Bay, a large estuary, and Port Royal Sound all lie within easy driving distance of the University Campus. A boathouse and a field laboratory are located on the Baruch Plantation.

Graduate work is offered leading to Bachelor of Science, Master of Science and Doctor of Philosophy degrees in marine science. For graduate degrees the following courses are required: marine geology, biological oceanography, environmental measurements and analysis, oceanographic techniques, and either marine geophysics or physical and chemical oceanography. The remainder of the program of study and other specific degree requirements will be planned in consultation with the director of the Marine Science program, the student and the graduate student advisory committee. The programs began in fall 1972.

UNDERGRADUATE

DEPARTMENT OF GEOLOGY

GEO	503	Introduction to Oceanograhpy	3
GEO	545	Marine Geology	3
GEO	546	Marine Geophysics	3

INTERDEPARTMENTAL COURSES

Marine Sci	101	The Present Day Marine Environment	4
Marine Sci	102	The Origin and Evolution of the Marine Environment	4
Marine Sci	201	Introduction to Oceanography	3
Marine Sci	202	Marine Biology	4
Marine Sci	399	Independent Study	3-6

GRADUATE

DEPARTMENT OF BIOLOGY

BIO	550	Biology of Polluted Waters	4
BIO	650	Biological Oceanography	3
BIO	722	Aquatic Bacteriology	4
BIO	720	Advanced Mycology	3
BIO	727	Marine Phytoplankton	3
BIO	729 730	The Biology of Fish	3
BIO	731	Advanced Invertebrate Zoology	3
BIO	750	Advanced Biological Oceanography	3
BIO	754	Oceanographic Techniques	1
BIO	755	Environmental Measurements and Analysis	3

DEPARTMENT OF GEOLOGY

GEO	722	Aqueous Geochemistry	3
GEO	753	Shoreline and Littoral Processes	3

The instruction staff for the courses listed above consists of the following:

D. L. Claybrook, Ph. D., Associate Professor of Biology
G. T. Cowley, Ph. D., Associate Professor of Biology
J. M. Dean, Ph. D., Associate Professor of Biology
P. J. DeCoursey, Ph. D., Assistant Professor of Biology
L. P. Lovelace, Ph. D., Associate Professor of Biology
L. H. Stevenson, Ph. D., Associate Professor of Biology
F. J. Vernberg, Ph. D., Professor of Biology and Director of Belle W. Baruch Coastal Research Institute
W. B. Vernberg, Ph., D., Research Professor, Biology
N. Watabe, D. Sc., Associate Professor of Biology and Director of Electron Microscope Lab.
R. G. Zinkmark, Ph. D., Assistant Professor of Biology

W. L. Linder, Ph. D., Associate Professor of Computer Science

R. D. Bonnell, M. S. M. E., Associate Professor of Engineering
M. W. Davis, Ph. D., Professor of Engineering
R. A. Holmes, Ph. D., Professor and Dean, College of Engineering
W. H. Hoppmann, Ph. D., Professor of Engineering
R. O. Pettus, Ph. D., Assistant Professor of Engineering

J. R. Carpenter, Ph. D., Associate Professor of Geology
F. Caruccio, Ph. D., Associate Professor of Geology
D. J. Colquhoun, Ph. D., Professor and Head, Department of Geology
T. T. Davies, Ph. D., Associate Professor of Geology

R. L. Gardner, Ph. D., Assistant Professor of Geology
M. O. Hayes, Ph. D., Professor of Geology
W. H. Kanes, Ph. D., Associate Professor of Geology
D. R. Lawrence, Ph. D., Associate Professor of Geology
B. W. Nelson, Ph. D., Professor of Geology and Vice Provost of Advanced Studies and Research
L. D. Neuman, Ph. D., Assistant Professor of Geology

J. E. Montgomery, LL. M., Assistant Professor of Law
C. Randall, LL. M., Professor of Law

To obtain further information, address all inquiries directly to:

Mr. John Vernberg, Marine Science Program Director
University of South Carolina
Columbia, South Carolina 29208

UNIVERSITY OF SOUTH FLORIDA
St. Petersburg, Florida 33701

The Department of Marine Science of the University of South Florida is an interdisciplinary unit offering the Master's degree in biological, chemical, geological or physical oceanography. An undergraduate degree is not offered.

Teaching and research laboratories, offices, large and small vessel facilities of the department are located on the St. Petersburg campus. This campus occupies a peninsula about one block wide and two blocks long that extends into Bayboro Harbor, a protected bay opening into Tampa Bay. There are a number of buildings providing adequate space for faculty and graduate students and housing research and teaching equipment. The department operates a fleet of small boats, including two inboard vessels of 36 feet in length, and a number of boats powered by one or two outboard motors. A field station providing overnight accommodations as well as laboratory facilities is maintained near Tarpon Springs, about 35 miles north of St. Petersburg.

The research program of the Department of Marine Sciences includes both inshore environmental studies and offshore oceanography. Faculty members serve as chief scientists and are accompanied by their graduate students on six or eight cruises a year on research vessels. In addition, cruises on smaller vessels are provided by the office of the state university system Institute of Oceanography, located on the St. Petersburg campus. Inshore environmental studies extend from the Florida Keys to the west side of the Mississippi delta. Offshore studies are concerned primarily with the Gulf of Mexico and the Caribbean Sea, though not limited to these areas.

Students in the master's degree program are required to complete 45 quarter hours of graduate level courses which must include three of the four basic graduate courses: biological, chemical, geological and physical oceanography. A thesis is required, for which nine quarter hours credit is allowed.

Most graduate students in the program are supported by half-time research assistantships.

The following courses are examples of those offered as part of or in conjunction with the master's degree in marine science:

OGY 521	Chemical Oceanography	4
OGY 531	Geological Oceanography	4
OGY 541	Physical Oceanography	4
OGY 551	Biological Oceanography	4
OGY 583	Selected Topics in Oceanography	1-4
OGY 610	Scientist-in-the Sea I, Hyperbaric Operations	4
OGY 611	Scientist-in-the Sea II, Research Techniques	4
OGY 612	Scientist-in-the-Sea III, Underwater Engineering	4
OGY 622	Methods in Chemical Oceanography	2
OGY 632	Methods in Geological Oceanography	2
OGY 633	Sedimentary Petrology of the Oceans	4
OGY 642	Methods in Physical Oceanography	2
OGY 643	Oceanographic Engineering	4
OGY 650	Marine Algal Ecology	3
OGY 651	Marine Plankton Systematics	4
OGY 652	Methods in Biological Oceanography	2
OGY 653	Marine Plankton Ecology	4
OGY 656	Benthic Marine Ecology	5
OGY 683	Selected Topics in Oceanography	1-4
BIO 543	Phycology	5
BIO 547	Marine Botany	5
BIO 519	Ichthyology	5
BIO 520	Biology of Echinoderms	5
BIO 546	Marine Invertebrate Zoology	5
BIO 623	Physiology of Marine Animals	5
CHM 661	Marine Chemistry	4
GEO 621	Marine Micropaleontology	6

The instructional staff for the courses listed above includes the following:

Baird, Ronald C., Ph. D., Assistant Professor
Betzer, Peter R., Ph. D., Assistant Professor
Blake, Norman J., Ph. D., Assistant Professor
Carder, Kendall L., Ph. D., Assistant Professor
Doyle, Larry J., Ph. D., Assistant Professor
Fanning, Kent A., Ph. D., Assistant Professor
Hopkins, Thomas L., Ph. D., Assistant Professor
Humm, Harold J., Ph. D., Professor
Pyle, Thomas E., Ph. D., Assistant Professor

For further information, address all inquiries directly to:

Dr. Harold J. Humm, Chairman
Department of Marine Science
University of South Florida
St. Petersburg, Florida 33701
(813) 898-7411

SOUTHEASTERN MASSACHUSETTS UNIVERSITY
North Dartmouth, Massachusetts 02747

Southeastern Massachusetts University offers courses in coastal zone ecology, marine biology and ocean engineering. A research vessel is berthed at nearby New Bedford harbor; smaller craft are moored in nearby estuaries. The university is developing a coastal zone laboratory facility at its newly acquired oceanfront site on Gooseberry Neck some 14 miles from the North Dartmouth campus.

Most research and teaching activities are centered in modern laboratories in the science, engineering and research building in North Dartmouth. The buildings are of recent construction and house a range of laboratory facilities including controlled temperature aquatic rooms which have both salt water and fresh water aquaria. A pesticide residue analysis laboratory, plankton analysis laboratories, and other laboratories containing radiation counting equipment, scanning electron microscope, and transmission electron microscope are located in the new campus.

The 64-foot RV Corsair is especially equipped with experimental trawling gear, a continuous recording STDO probe as well as conventional analytical and oceanographic apparatus.

The university offers the following degrees:

1. B.S. Marine Science Option in Biology. A special undergraduate curriculum in marine science emphasize upper division course work dealing with organisms of the coastal zone environment.

2. M.S. in Marine Biology. A graduate program in marine science places special emphasis on research involvement of master's degree students in research projects in ecology and marine biology.

A student enrolling in the graduate program in biology plans his course work and research program with the assistance of his advisor. Selection of courses and research problems is correlated with the background and occupational objectives of the student. Although all graduate students are urged to carry out a research project and write a master's thesis, it is possible for students who do not contemplate a career in research to earn their master's degree on the basis of successful completion of course work.

A minimum of 30 credits and a grade point average of 3.0 are required of all master's degree candidates. Students are encouraged to include appropriate course selections in mathematics, the physical sciences and engineering as well as in biology.

The following courses are offered in conjunction with the biology programs:

314	General Ecology	4
315	The Biology of the Algae	4
317	The Biology of Invertebrate Animals	4
406	Life in the Seas I	3
407	Life in the Seas II	3
411	Proseminar: Current Topics in Biology	1-3
413	The Biology of Fishes	4
414	Comparative Physiology	4
415	Limnology	4
416	Life in the Seas, Lab I	1
417	Life in the Seas, Lab II	1
430	Design of Experiments	4
440	Research Project	2
509	Directed Study in Biology	1-2
511	Graduate Seminar in Biology	1-3
511A	Trophic Dynamics	
511B	Physiology of Pollutants	
511C	Coastal Zone Processes	
511D	Estuarine Ecology	
511E	Biological Control	
511F	Marine Parasitology	
517	Advanced Biology of Invertebrate Animals	4
520	Animal Behavior	3
521	Microbial Ecology	4
531	Advanced Ichthyology	4
532	Sharks and Rays	3
544	General Oceanography	4
545	Biological Oceanography	4
593	Graduate Research Project	1-3
599	Graduate Thesis	10

A special summer program is offered in Coastal Zone Marine Biology, a sequence of courses offering a brief intensive introduction to specialized areas of marine biology. The summer offerings include:

Biology of Sharks and Rays
Biology of Marine Invertebrates
Marine Microbiology and Mycology
Biological Aspects of Marine Pollution
Biology of Osteichthyes
Biology of Diatoms
Ecology of the Coastal Zone

The summer studies place special emphasis on experience in laboratory, field and shipboard procedures. The proximity of Buzzards Bay, its estuaries and the Atlantic Ocean offer special advantages for intensive environmental experiences.

The instructional staff for the courses listed above consists of the following:

Asato, Yukio, Ph.D., Assistant Professor
Campbell, Ronald A., Ph.D., Assistant Professor
Cotter, David A., Ph.D., Assistant Professor
Cox, James L., Ph.D., Assistant Professor
Edgar, Robert K., Ph.D., Assistant Professor
Hoff, James G., Ph.D., Professor
Ibara, Richard M., Ph.D., Assistant Professor
MacDonald, Paul W., Ph.D., Assistant Professor
Matsumoto, Barton M., Ph.D., Assistant Professor
Moss, Sanford A., Ph.D., Associate Professor
Mulcare, Donald J., Ph.D., Assistant Professor
Nakamura, Royden, Ph.D., Assistant Professor
O'Brien, Frank, Ph.D., Assistant Professor
Reardon, John J., Ph.D., Professor
Sasseville, Normand, Ed.M., Professor
Szal, Roger, Ph.D., Assistant Professor
Whitaker, Ellis, Ph.D., Professor

To obtain further information, address all inquiries directly to:

Dr. John J. Reardon
Chairman, Department of Biology
Southeastern Massachusetts University
North Dartmouth, Massachusetts 02747

The following degrees are offered by the Departments of Electrical Engineering, Mechanical Engineering and Civil Engineering respectively:

1. B.S. in Electrical Engineering (Ocean Option). The student electing the ocean option in electrical engineering is required to take a six-course sequence in ocean science and engineering as part of his curriculum.

2. B.S. in Mechanical Engineering (Ocean Option). The student electing the ocean option in mechanical engineering is required to take a six-course sequence in ocean science and engineering as part of his curriculum.

OE 396	Physical Oceanography I	3
OE 491	Underwater Acoustics	3
OE 492	Ocean Waves	3
OE 494	Ocean Instrumentation	3
OE 495	Fundamentals of Ocean Engineering I	3
OE 496	Fundamentals of Ocean Engineering II	4

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF ELECTRICAL ENGINEERING

Fain, Gilbert, Ph.D., Associate Professor
Gonsalves, Lenine, M.S., Professor
Massey, Allen, M.S., Visiting Lecturer (part-time)
Serotta, Norman, M.S., Instructor (part-time)
Shonting, David, Sc.D., Visiting Lecturer (part-time)

To obtain further information, address all inquiries directly to:

Dean, College of Engineering
Southeastern Massachusetts University
North Dartmouth, Massachusetts 20747

UNIVERSITY OF SOUTHERN CALIFORNIA
University Park, Los Angeles, California 90007

The university offers marine science courses at both its main campus in downtown Los Angeles and at its new Marine Sciences Center on Santa Catalina Island, 22 miles offshore from the Los Angeles Coastal Plain. The univer-

sity was founded in 1880 and marine research and course work was organized in the early 1900's. The impetus for a much-expanded effort in marine sciences came with the gift of the research vessel Velero III and the endowment of the Hancock Foundation in 1939 by Capt. G. A. Hancock. Following the requisitioning of the Velero III as a patrol craft in World War II, Capt. Hancock built a new research ship, launched in 1948, and given to the university. The Velero IV is based on the utilitarian Pacific Tuna Clipper design, but was built from the keel up for ocean research. The ship is 110 feet long and provides berthing for a crew of 11 and nine scientists.

In addition to the Velero IV, a coastal research vessel, the Golden West, a 43-foot converted charter fisheries boat, is also maintained by the foundation. A cruiser, the Espoir, 34 feet long, is used for transporting personnel to and from the marine laboratory at Catalina. The two small vessels have full-time skippers and a technician-seaman is also provided aboard the Golden West. The latter has complete navigation and communication equipment as well as a small hydrographic winch with 1,000 meters of stainless wire. The Velero IV is equipped with several winches, the largest being capable of working to depths of 4,000 meters with loads of up to a few tons for heavy trawling, dredging, and coring.

The Catalina Marine Sciences Center is a newly established research facility for marine sciences at Santa Catalina Island. The center is operated academically on a consortium basis. Participating institutions include: University of California campuses at Los Angeles and Irvine, California Institute of Technology, Occidental College, and the University of Southern California. Students are drawn from all participating institutions by registering through their home universities. Teaching staff assignments are also made by the members of the consortium from their own faculties. Courses offered at Catalina are listed in the catalogs of all participating institutions and reciprocal credit is automatically granted. Sub-committees of the Inter-University Advisory Committee provide assistance in planning for academic programs as well as site development and other planning and operational functions. There is about 10,000 sq. ft. of laboratory space equipped with running sea water and with facilities for research of all types including electron microscopy. A fully equipped locker for diving is supported with underwater equipment for photography, television camera studies, and acoustics. A permanent staff is in residence and space for up to 32 students and a dozen researchers is available. The first building, the Santa Catalina Marine Biological Laboratory, has been completed and its educational and research programs are being managed by the Department of Biological Sciences and the Allan Hancock Foundation.

Specialized laboratories for various areas of marine geology, geophysics, geochemistry, ecology and oceanography are located in the spaces of the Department of Geological Sciences on campus. Ocean engineering and coastal engineering laboratories are active in the School of Engineering and several specialized biological sciences laboratories are located in Old Science Hall. The Hancock Foundation Building houses some of the marine geology and paleoecology laboratories as well as the bulk of the marine biology facilities. The Sea Grant Program is housed near-by.

A major computer facility and several excellent libraries including the Hancock Library for Oceanography and Marine Biology round out a broad spectrum of facilities on the main campus.

The Law Center is in the process of acquiring a library of materials relating to pollution and resource management of the marine environment. The library will have several hundred volumes, including serials, and will be separately shelved in the law library.

A total of 109 marine-oriented educational courses are offered by the 15 academic departments. Six advance degrees with a specialty in marine sciences or marine affairs are offered by five of these disciplines. Many academic departments have a major portion of their faculty full-time in either the marine sciences or marine affairs. One department has as much as a two-thirds commitment. This faculty is also engaged in extensive research within their respective fields. Research costing as much as $4 million a year is conducted by USC researchers and educators.

The Allan Hancock Foundation is entirely devoted to the marine sciences. Recent research projects have involved the Los Angeles-Long Beach Harbor, oil pollution, benthic biomass, and midwater flora and fauna. The baseline studies conducted on a continuous basis are now being used as an essential component in most environmental impact reports. The foundation possesses one of the largest collections of marine invertebrates and algae on the Pacific Coast. The extensive Hancock library produces a regular monograph of ongoing research. The Hancock Foundation has 120,000 square feet of gross space.

The Sea Grant Program at the University of Southern California is primarily concerned with coastal resources development and management. The program plans to expand its contribution in selected phases of scientific and technological development of the resources of the sea and to increase the nation's capability to utilize effectively those resources by contributing to certain areas of law, business administration, economics, public administration and other fields which are directly concerned with planning and managing ocean resources.

During the fiscal year 1972-73, 15 project leaders, 15 associates, five research associates, 18 graduate students, seven undergraduate students, and 12 secretaries were involved in the program. The Sea Grant Program is currently in its third year of funding with institutional support.

The Department of Biological Sciences offers 28 graduate courses and eight undergraduate courses in marine biology. A Ph. D. in Biological Sciences with a specialization in marine sciences is offered by the department. The department has a faculty of nearly 50 percent in marine biology, plus two graduate doctoral programs. Laboratories exist in Science Hall, Hancock Foundation, and the Ahmanson Center for Biological Research, as well as at the Catalina Marine Sciences Center.

The Department of Geological Sciences offers eight graduate courses and six undergraduate courses in marine geology. An M. S and Ph. D. in Geological Sciences with a specialization in marine sciences is offered. The department has a faculty of more than 50 percent in marine sciences. Since 1960, 22 Ph. D. dissertations and 42 Master dissertations have been published in the marine sciences.

Facilities for the Department of Geological Sciences include laboratories for sediment and micropalcontology, a geochemistry laboratory, and a geomorphology and geophysics laboratory. The department owns a small Boston Whaler for coastal research. Ninety to 120 days a year of ship time are allocated on the Velero IV and the Golden West. Within the department is a small library containing journal holdings in the marine sciences. Eight faculty members conduct research in a broad range of areas from bottom topography to environmental aspects of coastal geology.

The collective group in the Division of Engineering and Applied Mechanics (Departments of Aerospace, Civil, Environmental, and Mechanical Engineering) offer an M. S. in Ocean Engineering. The respective course offerings are:

Aerospace Engineering	5 courses
Civil Engineering	14 courses
Environmental Engineering	2 courses 5 (planned)
Mechanical Engineering	3 courses
Chemical Engineering	5 (indirect)

The School of Medicine offers two courses on the medical campus: physiology and advanced methods of underwater research.

The staff of the Center for Urban Affairs has a large capacity for social science research in marine affairs. There are four faculty members and two doctoral students actively involved in marine affairs research. The main interest and work of the staff will concern management of the coastal zone and regional use of the coastal zone. For

the next two or three years, some seminar research and some doctoral dissertations in marine affairs will be produced. Two graduate courses are offered.

The Graduate School's role is to provide a graduate education program leading to a Master of Public Administration degree with specialization in marine affairs.

The Law Center offers five courses in coastal and maritime law. An outstanding collection of books and serials have been acquired with Sea Grant funding for their library. Research is being conducted on tax and non-tax alternatives for effectuating allocation of oceanic resources.

The five courses taught in the School of Business Administration are indirect in nature to marine affairs, but still very applicable. In a research sense, this school represents a vast resource of personnel who could lend their business and economic talents to the issues of coastal zone management.

The following degrees are offered by the departments indicated:

1. Ph.D. in Geology with specialization in Marine Geology, Geophysics and Geo-Chemistry of the Oceans (Department of Geological Sciences). The requirements for the doctorate follow the general requirements of the Graduate School and generally require a minimum of four years to complete. Only students of high ability are accepted for candidates after demonstrating their competence in a screening examination in the first year, a comprehensive written and oral examination after two years, and the successful defense of the original dissertation. Usually the student is required to either successfully demonstrate a reading knowledge of two foreign languages or they may substitute their competence in statistics of computer use or an advanced basic science minor. The path of the student studies are directed by the Guidance Committee following the successful passing of the screening examination. There were two graduates of this program last year.

2. M.S./M.A. in Geological Sciences with specialization in Marine Geology and Oceanography (Department of Geological Sciences). Master's degree candidates must have the same entrance qualifications as above and must have passed 24 hours of graduate course work with a grade point average of 3.0/4.0. A thesis is required. The master's committee is selected after the screening examination of the first year is successfully passed. The master's is generally required before the Ph.D. can be sought except in exceptional cases of ability. A master's degree normally requires two years to complete. There were two graduates of this program last year.

3. Ph.D. in Biological Sciences with specialization in Marine Sciences (Department of Biological Sciences). Degrees at the master's and doctoral levels are offered. After admission to the program, students are given a background examination in the major fields of biology. Students prepare a curriculum of course and research training in consultation with their advisory and guidance committee. Although the qualifying examination in the second year is common to all doctoral students, there is considerable specialization by those engaged in areas of marine science. Shipboard experience as well as teaching assistance experience is required for students engaged in relevant oceanic biology research areas. A thesis topic demonstrating an ability to undertake independent research is demanded. The areas of research are defined mainly by faculty interests and include marine ecology. There were 15 graduates of this program last year.

4. Master's of Public Administration with specialization in Marine Affairs (School of Public Administration). The general core of courses in the master's program provide students with the basic knowledge required to operate effectively in the arena of public affairs. The specialty courses are designed for students planning careers in the marine community. The latter courses are essentially interdisciplinary. Although desirable, prior work in the social sciences need not be extensive. This program usually takes two years after a bachelor's with a thesis requirement. There will be six graduates of this program in this academic year.

5. M.S. in Ocean Engineering (Division of Engineering and Applied Mechanics). The M.S. program in Ocean Engineering at USC is directed toward preparing students for a professional career in any one of a variety of ocean-oriented engineering activities. The program is interdisciplinary in nature and flexible enough to satisfy the needs of individual students with a variety of backgrounds and interests. Applicants with a bachelor's degree in any of the engineering or science areas who have ability to pursue graduate study are eligible for this program. Students are required to take course work and pass a comprehensive examination; normally it requires only one academic year of full-time study beyond the B.S. level. There were four graduates of this program last year.

6. M.S. in Environmental Engineering (Division of Engineering and Applied Mechanics). The M.S. program in Environmental Engineering is directed toward preparing students for a professional career in any one of a variety of environmental engineering activities. The program is interdisciplinary in nature and flexible enough to satisfy the needs of individual students with a variety of backgrounds and interests. Applicants with a bachelor's degree in any area of engineering or science who have the ability to pursue graduate study are eligible for this program. Students are required to take course work and pass a comprehensive examination; normally it requires only one academic year of full-time study beyond the B.S. level. There were 10 graduates of this program last year.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE COURSES

DEPARTMENT OF BIOLOGICAL SCIENCES

100	Topics in Biology: Cells and Organisms	4
102	Topics in Biology: Man and His Environment	4
106abL	General Biology	4
301L	Fundamentals of Invertebrate Biology	4
302L	Fundamentals of Vertebrate Biology	4
315L	Ecological and Evolutionary Biology	4
331L	Comparative Morphology of Nonvascular Plants	4
404L	Ecology	4

DEPARTMENT OF ECONOMICS

455	Urban and Regional Economics: Marine Transportation and Environmental Issues	4

SCHOOL OF ENGINEERING

DEPARTMENT OF AEROSPACE ENGINEERING

470	Man's Influence on His Environment, Pollution, and Control	3

DEPARTMENT OF CHEMICAL ENGINEERING

462	Introduction to Air Pollution	4
464	Air Pollution Control	

DEPARTMENT OF CIVIL ENGINEERING

443	Environmental Chemistry	3
451	Hydraulic Engineering	3
453	Water Quality Control	3
463L	Environmental Engineering Laboratory	3
465	Water Supply and Sewerage System Design	3

DEPARTMENT OF MECHANICAL ENGINEERING

472	Power Plant Design	3

DEPARTMENT OF GEOLOGICAL SCIENCES

107L	Elements of Oceanography	4
215L	Petrology	
333L	Paleontology	3
405L	Urban Geology	3
408	Applied Mathematics for Geologists	4

412	Oceanography for Engineers and Scientists	3
440	General Geophysics	4
451L	Geomorphology	3
460L	Geochemistry	4

URBAN STUDIES

430	Planning, Policy-Making and Social Change	4

GRADUATE COURSES

DEPARTMENT OF BIOLOGICAL SCIENCES

508L	Marine Invertebrate Zoology	5
509abL	Advanced Invertebrate Zoology	4
519	Recent Advances in Marine Biology	2-8
520L	Marine Botany	5
522L	Tropical Marine Biology	
529	Marine Fouling and Pollution	3
531	Seminar in Marine Invertebrate Zoology	2
541L	Protozoology	4
542L	Ichthyology	4
546L	Crustacean Biology	4
547L	Malacology	4
550	Advanced Neurophysiology	4
560L	Marine Invertebrate Physiology	5
561L	Physiological Ecology of Marine Organisms	5
562L	Natural History of Santa Catalina Island	5
563L	Electrobiology	5
564L	Feeding and Digestion in Invertebrates	5
565L	Biology of Marine Vertebrates	5
566L	Physiology of Marine Vertebrates	5
567L	Marine Plankton Ecology	5
568L	Advanced Marine Invertebrate Biology	5-10
572L	Marine Ecology	5
573L	Marine Ecology	4
574L	Marine Plankton Ecology	4
580L	Special Topics in Marine Biology	5-10
581L	Current Problems in Marine Sciences	5-10
582L	Oceanology	5
583L	Comparative Physiology of Marine Animals	5
586L	Developmental Biology of Marine Organisms	5

DEPARTMENT OF BUSINESS ADMINISTRATION

531	Management of Science and Technology in Business	4
532	Business Modeling and Simulation	4
581	Analysis of the Food Industry	2
582	Food Distribution Administration	2
590	Directed Research	2-4
595	Resource Pricing and Capital Formation	4

DEPARTMENT OF ECONOMICS

555	Regional, Spatial and Environmental Economics	4

SCHOOL OF ENGINEERING

DEPARTMENT OF AEROSPACE ENGINEERING

510ab	Dynamics of Incompressible Fluids	4
616	Ocean Measurements	3
620	Aero and Hydrodynamic Wave Theory	3
621	Stability of Fluids	4
623ab	Dynamics of Stratified and Rotating Flows	3
624ab	The Fluid Dynamics of Natural Phenomena	3
625	Laminar Boundary Layer Theory	4
652	Turbulent Shear Flows	4

DEPARTMENT OF CHEMICAL ENGINEERING

516	Chemical Reactions in the Atmosphere	3
527	Corrosion	3
545	Corrosion Control in Petroleum Production	2

DEPARTMENT OF CIVIL ENGINEERING

513L	Instrumental Methods for Environmental Analysis	3
514ab	Advanced Sanitary Engineering Design	3
515ab	Environmental Health Engineering	3
517	Industrial Waste Treatment	3
520	Ocean and Coastal Engineering	3
534	Waterfront Construction	3
555	Underwater Structures	3
562ab	Hydromechanics	3
563	Chemistry and Biology of Natural Waters	3

DEPARTMENT OF ENVIRONMENTAL ENGINEERING

501	World Resources - Renewable and Non-Renewable	3
502	Engineering and the Biosphere	3
Planned:		
516	Chemical Reactions in the Atmosphere	3
518	Seminar in Environmental Engineering	2
523	Physical Processes of Environmental Engineering	3
553	Chemical and Biological Processes in Environmental Engineering	3
613	Advanced Topics in Environmental Chemistry	2

DEPARTMENT OF MECHANICAL ENGINEERING

508	Design for Ocean Environment	
529	Underwater Acoustics	

DEPARTMENT OF GEOLOGICAL SCIENCES

500L	Marine Paleoecology	4
510	Sedimentary Processes	3
511L	Sedimentary Techniques	4
512	Introductory Oceanography	3
514	Marine Geology	3
521	Taxonomy	3
529	Terrestrial Heat Flow	4
531	Geotectonics	3
536	Seminar in Engineering Geology	4
537L	Applied Geophysics	4
540	Physics of the Earth's Interior	4
560	Marine Geo-Chemistry	
563	Chemical Oceanography	4
577L	Micropaleontology	4
578L	Advanced Micropaleontology	4
600	Seminar	4
610	Probability and Stochastic Processes for Geophysicists	4
640	Advanced General Geophysics	4

SCHOOL OF LAW

724	Legal Problems of Coast and Tidelands Resources: Policies and Procedures for Reconciling Economic Development and Environmental Quality	3
728	Admiralty	2
663	Law of World Organizations	2
861	International Law Seminar	2

SCHOOL OF MEDICINE

580L	Advanced Methods in Underwater Research	
630	Physiology	4

SCHOOL OF PUBLIC ADMINISTRATION

501	Problems and Issues in Environmental Management	4
575	Science, Technology, and Government	4
576	Problems and Issues in Coastal Zone Management	4
577	Problems in the Administration of R&D	4
578	Marine Science Affairs	4

DEPARTMENT OF SOCIOLOGY/ANTHROPOLOGY

540	Population and Ecological Analysis	4
542	Seminar in Human Ecology	4

DEPARTMENT OF URBAN AND REGIONAL PLANNING

590	Directed Research	2-4
620	Advanced Seminar in Planning Coordination and Implementation	2
680	Cove Laboratory - Workshops	8
6811.	Integrative Laboratory - Workshop	
684	Laboratory - Seminar in Policy Planning and Management	4

DEPARTMENT OF URBAN STUDIES

682	Urban Policy Making	4

The instructional staff for the courses listed above consists of the following:

BIOLOGICAL SCIENCES AND HANCOCK FOUNDATION

Abbott, Bernard C., Ph.D., Professor and Chairman and Director of Hancock Foundation
Bakus, Gerald J., Ph.D., Associate Professor
Fauchald, Kristian, Ph.D., Assistant Professor and Curator of Polychaetes (AHF)
Fernandez Y. Cossio, Hector R., Ph.D., Assistant Professor
Garth, John S., Ph.D., Professor, Senior Curator and Curator of Crustaceans (AHF)
Hartman, Olga, Ph.D., Emeritus Curator of Polychaetes (AHF)
Jones, Gilbert, Ph.D., Associate Professor
McLean, James H., Ph.D., Adjunct Professor
Mohr, John L., Ph.D., Professor and Curator of Protozoa (AHF)
Nafpaktitis, Basis G., Ph.D., Associate Professor
Nicholson, Nancy L., Ph.D., Assistant Professor and Curator of Algae (AHF)
Pieper, Richard E., Ph.D., Assistant Professor
Savage, Jay M., Ph.D., Associate Director (AHF) and Professor
Soule, John D., Ph.D., Curator of Bryozoa (AHF) and Professor of Histology
Straughan, Dale M., Ph.D., Principal Investigator, Oil Pollution (AHF)
Ziesenhenne, Fred C., Curator of Echinoderms (AHF)

SANTA CATALINA MARINE BIOLOGICAL LABORATORY

Given, Robert R., Ph.D., Assistant Director
Zimmer, Russel L., Ph.D., Resident Director

GEOLOGICAL SCIENCES

Bandy, Orville L., Ph.D., Chairman and Professor
Bischoff, James L., Ph.D., Associate Professor
Davis, Gregory A., Ph.D., Associate Professor
Gorsline, Donn S., Ph.D., Professor
Henyey, Thomas L., Ph.D., Assistant Professor
Ku, Richard T., Associate Professor
Pipkin, Bernard W., Ph.D., Senior Lecturer
Teng, Ta-liang, Ph.D., Associate Professor

AEROSPACE ENGINEERING

Laufer, John, Ph.D., Chairman and Professor, and Chairman, Division of Engineering and Applied Mechanics
Maxworthy, Tony, Ph.D., Professor
Troesch, B., Andreas, Ph.D., Professor

CIVIL ENGINEERING

Bowerman, F. R., Ph.D., Professor
Browand, Fred K., Ph.D., Assistant Professor
Butler, Stanley S., Associate Professor
Chen, Kenneth Y., Ph.D., Assistant Professor
Lee, J. J., Ph.D., Visiting Assistant Professor
Masri, Sami F., Ph.D., Associate Professor

MECHANICAL ENGINEERING

Binder, Raymond C., Ph.D., Professor
Siegel, Martin J., M.S., Associate Professor

DEPARTMENT OF ECONOMICS

Vincent, Phillip E., Assistant Professor

SCHOOL OF PUBLIC ADMINISTRATION

Clayton, Ross, Ph.D., Assistant Professor
Tysen, Frank, MPA

SOCIOLOGY/ANTHROPOLOGY

Friedman, Judith, Ph.D., Assistant Professor
Rice, Rodger R., Ph.D., Assistant Professor
Van Arsdol, Maurice D., Ph.D., Professor

URBAN STUDIES

Warren, Robert, Ph.D., Professor

URBAN AND REGIONAL PLANNING

Schultz, George, Ph.D., Associate Professor
Weschler, Louis, Ph.D., Associate Professor

SCHOOL OF MEDICINE

Pilmanis, Andreas A., Instructor
Russell, Findlay E., Ph.D., Professor

CATALINA MARINE SCIENCE CENTER

Tibby, Richard B., Ph.D., Director and Professor

To obtain further information, address all inquiries directly to:

Dr. Bernard C. Abbott
Director, Allan Hancock Foundation
University of Southern California
University Park
Los Angeles, California 90007

SOUTHERN MAINE VOCATIONAL TECHNICAL INSTITUTE
South Portland, Maine 04106

Facilities at the institute include a training vessel, the 144-foot Aqualab III, seamanship lab, marine engineering lab, physics lab, chemistry lab, marine biology and oceanography lab, and library facilities with up-to-date collections.

Students spend a percentage of the school year at sea on the training vessel. Methods of instrumentation and shipboard laboratory techniques in oceanography are included as part of the course. Participation includes deck, engine room and oceanographic station watch. Discipline aboard the vessel meets the rigid demands of maritime requirements.

The institute is located on Casco Bay overlooking the Gulf of Maine.

The following degrees are offered:

1. AAS in Applied Marine Biology and Oceanography. Requirements: 73 credit hours, four biology and four oceanography courses, two physics, two math and one chemistry course, 12 credits in humanities and 64 hours of sea duty per semester.

2. AAS in Marine Science. Requirements: 73 credit hours, two biology and two oceanography courses, one math and one physics course, 12 credits in program electives related to deck or engineering ship courses, nine credits in free electives, 12 credits in humanities, and 160 hours of sea duty per semester.

3. Industrial Marine Science. Requirements: The same as in AAS Marine Science without the requirements of 12 credits in humanities courses.

The following courses are offered in conjunction with the above programs:

APPLIED MARINE BIOLOGY AND OCEANOGRAPHY

Bio 111.1	General Biology	4
Oco 111.1	Introduction to Oceanography	4
Oco 112.1	Instrumentation and Methods in Oceanography	4
Bio 113	Invertebrate Zoology	4
Nav 21	Survey of Navigation	3
Bio 212	Ecology	4
Oco 211	Analytical Methods	4
Bio 211	Microbiology	4
Oco 212.1	Physical and Geological Oceanography	4

Electives

Bio 242	Planktology	4
Bio 244	Microtechnique	4
Bio 246	Marine Botany	4
Bio 248	Fishery Science	4

MARINE SCIENCE

Bio 111.2	General Biology	3
Oco 111.2	Introduction to Oceanography	3
MS 111	Marine Engineering I	3
MS 115	Seamanship I	1
MS 117	Small Boat Operating	0.5
SEA 111	Sea Time I	3
Bio 112	Marine Biology	3
Oco 112.2	Instrumentation and Methods in Oceanography	3
MS 112	Marine Engineering II	3
MS 114	Navigation II	2
MS 116	Seamanship II	1
MS 118	Small Boat Operating II	1

The instructional staff for the courses listed above consists of the following:

Arlander, Richard P., B.A., Instructor
Banerjee, Tapan, M.S., Chairman, Department of Marine Science and Technology
Doughty, Aftin L., License, Assistant Engineer
Eayrs, Weston III, B.S., Instructor
Flahive, William J., Ph.D., Instructor
Goode, Robert E., M.S., Instructor
Goodwin, Charles F., B.S., Instructor
Hall, Charles W., B.S., Instructor
Hupper, George, License, Instructor
Lomoriello, Luigi S., B.S., Chief Mate
Siegel, Robert E., M.S., Instructor
Soucy, Robert D., B.S., Instructor
Turner, Norman W., License, Chief Engineer

For additional information, address all inquiries directly to:

Marthon G. Tolman
Dean of Admissions
Southern Maine Vocational Technical Institute
Fort Road
South Portland, Maine 04106

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
Hattiesburg, Mississippi 39401

The university is a part of the Mississippi-Alabama Sea Grant Consortium and a member of the Gulf Universities Research Consortium. The Department of Biology is closely affiliated with the Gulf Coast Research Laboratory (GCRL) at Ocean Springs, Miss., 90 miles away. This association allows use of the research vessels Hermes and Gulf Researcher, plus space, equipment and library facilities at GCRL. The department also utilizes the facilities of the National Marine Fisheries Service vessel, R/V Oregon on a space available basis.

The Department of Geology also cooperates closely with the GCRL.

The following degrees are offered in the basic sciences:

1. Ph.D. in Marine Biology. The Department of Biology offers a Ph.D. degree with majors in marine biology and in botany and zoology. All doctoral degrees entail a minimum of 78 semester hours of course work beyond the bachelor's degree or 48 semester hours of course work beyond the master's degree. Thirty-two quarter hours must be spent on the Hattiesburg campus. A final oral examination is administered after the dissertation is accepted.

2. M.A., M.S. in Biology. Candidates for the master of sciences degree or the master of arts degree must earn 30 semester hours of graduate credit, 12 of which should be in a minor area. A final oral comprehensive examination and an acceptable thesis are required.

3. M.A., M.S. in Geology. Candidates for the master of arts or master of science degree must earn 30 semester hours of graduate credit. For the M.A. degree, a candidate must take 12 hours of an approved academic minor, demonstrate proficiency in a foreign language and present an acceptable thesis. For the M.S. degree, a candidate must elect a minor (12 hours) in an approved field and present an acceptable thesis which must be defended.

Marine science courses are offered by the Departments of Biology and Geology during the regular academic year. Summer courses in marine biology and geology are offered at the Gulf Coast Research Laboratory. The following courses are offered:

DEPARTMENT OF BIOLOGY

567	Introduction to Biological Oceanography	3
581	Marine Vertebrate Zoology (GCRL)	6
583	Marine Invertebrate Zoology I (GCRL)	6
584	Marine Invertebrate Zoology II (GCRL)	6
589	Marine Botany (GCRL)	4
592	Special Problems in Biology I, II, III, IV	8
698	Thesis	4
728	Planktology	3
731	Physiology of Marine Animals	3
760	Topics in Marine Biology	2
763	Fisheries Biology	3
765	Biological Oceanography	3
676	Marine Ecology	3
782	Research in Marine Biology	arr.
791	Research in Biology	arr.
792	Special Problems	3
793	Research Zoology	6
798	Dissertation	--

DEPARTMENT OF GEOLOGY

505	Sedimentology	3
550	Introduction to Geological Oceanography	3
552	Physical Marine Geology (GCRL)	6
554	Chemical Marine Geology (GCRL)	6
556	Problems in Marine Sedimentation (GCRL)	6
703	Sedimentary Environments	3
791	Problems in Geology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Cliburn, Joseph W., Ph.D., Professor
Fish, Arthur G., Ph.D., Associate Professor
Grantham, Billy J., Ph.D., Associate Professor
Pessoney, George F., Ph.D., Chairman and Associate Professor
Thompson, John R., Ph.D., Associate Professor

DEPARTMENT OF GEOLOGY

Bowen, Richard L., Ph.D., Professor
Hoskin, Charles M., Ph.D., Chairman and Associate Professor
Paulson, Oscar L., Ph.D., Associate Professor

To obtain additional information, address all inquiries directly to:

Dr. Robert T. van Aller
Dean of the Graduate School
University of Southern Mississippi
Hattiesburg, Mississippi 39501

HOPKINS MARINE STATION
OF STANFORD UNIVERSITY
Pacific Grove, California 93950

The station occupies an exposed rocky headland, Mussel Point. The university holds title to about 11 acres on and around the point, which includes approximately one mile of shoreline. The intertidal and offshore waters surrounding the marine station are protected by law as a marine reserve and provide excellent resources for research and teaching in marine biology. The station operates as a branch of the Department of Biological Sciences of the university. The teaching and research facilities at the station are housed in three main buildings. The Agassiz Laboratory provides space and equipment for studies in the biology and ecology of marine invertebrates, fishes and algae. Special facilities include rooms equipped for microtechnique and photomicrography, a large aquarium room, a refcrence collection of marine invertebrates and the Gilbert M. Smith herbarium of marine algae. The two-story Jacques Loeb Laboratory provides rooms and other facilities for experimental studies on the development, physiology and biochemistry of marine animals, plants and microorganisms. Cold rooms, constant temperature rooms and a photographic darkroom are available. The laboratories are equipped with a wide variety of specialized equipment including a gas chromatograph, recording spectrophotometers, radiation counting equipment, high-speed refrigerated centrifuges, a preparative ultracentrifuge, neurophysiological equipment and facilities for electrophoresis and chromatography. The Marinostat houses two large laboratories, 10 smaller research rooms and six dark laboratories now being equipped for experimental temperature and light regimes. in addition to seawater at normal ocean temperatures, all laboratories are supplied with refrigerated seawater for maintaining lower temperatures. The library contains a constantly expanding collection of books in the fields most under study (algology, invertebrate zoology, development, ecology, physiology, biochemistry, microbiology and biological oceanography). The collection currently consists of some 16,000 volumes. About 500 serial publications in these fields are received.

Two small research vessels, the Tage, a 40.5-foot launch, and a 22-foot whaler are equipped with winches and oceanographic equipment for limited studies in Monterey Bay. Several small skiffs are available for inshore work.

The station offers the degree of Doctor of Philosophy in Biology. with specialization in algology, invertebrate zoology, development, ecology, physiology, biochemistry, or biological oceanography.

In addition, the station provides courses in marine biology and biological oceanography designed for matriculated and non-matriculated undergraduates and graduate and professional biologists during the summer quarter; a program of training in research for matriculated and non-matriculated undergraduates and graduates in biology during the spring (Biology 175II) and summer quarters (Biology 176II and 199II); students, after completion of Biology 175II, may continue their research during the summer by enrolling in Biology 176II or 199II; a program of graduate study and research in marine biology and biological oceanography leading to the degree of Doctor of Philosophy during all four quarters.

The following courses are offered in conjunction with the above programs:

100II	Marine Algae
111II	Marine Invertebrates
112II	Marine Invertebrates
118II	Phytoplankton
119II	Marine Ecology
120II	Marine Ecology.
176II	Problems in Biological Oceanography
199II	Special Problems
222II	Biological Oceanography
269II	Ecological Physiology
300II	Research

The instructional staff for the courses listed above consists of the following:

Abbott, Donald P., Ph.D., Professor of Biology and Associate Director, Hopkins Marine Station
Abbott, Isabella A., Ph.D., Research Biologist
Gilmartin, Malvern, Ph.D., Professor of Biology
Lee, Welton L., Ph.D., Assistant Professor of Biology
Phillips, John H., Ph.D., Professor of Biology and Director, Hopkins Marine Station

To obtain further information, address all inquiries directly to:

Hopkins Marine Station
Pacific Grove, California 93950

STEPHENS COLLEGE
Columbia, Missouri 65201

The college offers marine science courses at its temporary marine station on Key Largo, Florida, during each summer session. Supporting course work is offered on the main campus at Columbia, Missouri. Boats and facilities, including both dormitory and laboratory space, are rented on Key Largo for the program. Faculty, with laboratory equipment and a library, are moved from the main campus to Key Largo to conduct the program. The program is designed for the undergraduate student who wishes a biological science program with an emphasis in marine biology

The following degrees are offered:

1. The Associate in Arts degree concentrating in biology with an emphasis in marine biology (two-year program).

2. The Bachelor of Arts degree concentrating in biology with an emphasis in marine biology (four-year program).

The following courses are offered in conjunction with the above programs:

BIOLOGY

Bio 101	Biological Concepts	5
Bio 111	Floriculture	2
Bio 112	Floriculture	2
Bio 141	Conservation of Natural Resources	2
Bio 190's	Special Projects	arr.
Bio 211	Field Biology	3
Bio 231	Human Physiology and Anatomy	4
Bio 271	Biology of the Plants	3
Bio 275	Biology of the Invertebrates	3
Bio 277	Biology of the Vertebrates	3
Bio 280	Biology Seminar	1
Bio 281	Environmental Biology	3
Bio 285	Genetics	3
Bio 287	Organic Evolution	3
Bio 290's	Special Projects	arr.
Bio 311	Microbiology	4
Bio 321	Community Health	2
Bio 331	Introduction to Physical Anthropology	3
Bio 335	Montane Ecology	3
Bio 340's	Readings in Biology	arr.
Bio 340's	Projects in Biology	arr.
Bio 366	Taxonomic Systems	3
Bio 375	Paleobiology	3
Bio 377	Radiation Biology	3
Bio 379	Homeostatic Mechanisms	3
Bio 390's	Readings in Biology	arr.
Bio 390's	Projects in Biology	arr.
Bio 482	Senior Essay	--
Bio 483	Senior Project	arr.
Bio 490's	Readings in Biology	arr.
Bio 490's	Projects in Biology	arr.

MARINE BIOLOGY

Bio 217	Marine Biology I	3
Bio 218	Marine Biology II	3
Bio 290's	Projects in Marine Biology	arr.
Bio 390's	Projects in Marine Biology	arr.
Bio 482	Senior Essay in Marine Biology	4
Bio 483	Senior Project in Marine Biology	3

NATURAL SCIENCE

Nat Sci 101	Foundations of Natural Science	4
Nat Sci 102	Foundations of Natural Science	4
Nat Sci 255	Science Field Studies	2
Nat Sci 333	Science Practicum	--
Nat Sci 334	Science Practicum	--
Nat Sci 352	Scientific and Mathematical Inquiry	4
Nat Sci 355	Advanced Science Field Studies	--
Nat Sci 433	Science Practicum	--
Nat Sci 434	Science Practicum	--

CHEMISTRY

Chem 101	General College Chemistry	5
Chem 102	General College Chemistry	3
Chem 190's	Special Projects in Chemistry	arr.
Chem 201	Qualitative Analysis and Chemical Equilibrium	4
Chem 202	Quantitative Analysis	3
Chem 204	Organic Chemistry	4
Chem 290's	Special Projects in Chemistry	arr.

GEOLOGY

Geol 103	General Geology	5
Geol 190's	Special Projects in Geology	arr.
Geol 205	Common Rocks and Minerals	3
Geol 206	Life of the Geologic Past	3
Geol 290's	Special Projects in Geology	arr.
Geol 321	Field Geology	3

PHYSICS

Physics 101	College Physics	4
Physics 102	College Physics	4

The instructional staff for the courses listed above consists of the following (faculty are listed without rank since Stephens College has no ranking system):

Anderson, Harold, Ph.D.
Ansbacher, Carol, M.A.
Hansen, Harry, Ph.D.
Harvey, Amy E., Ph.D.
Howell, D. Lee, Ph.D.
Laun, H. Charles, M.S.
Novak, Alfred, Ph.D.
Otto, David A., Ph.D.
Ryan, Edward M., M.A.
Saunders, Richard, M.A.
Waxler, William L., M.S.

To obtain further information, address all inquiries directly to:

Dr. David A. Otto
Director of Marine Biology
Science Department
Stephens College
Columbia, Missouri 65201
(314) 442-2211, ext. 473

STEVENS INSTITUTE OF TECHNOLOGY
Hoboken, New Jersey 07030

The Davidson Laboratory is the center for research in ocean engineering at Stevens. The major facilities include: a 130-foot towing tank suitable for model studies of ships and other structures in regular or irregular seas; a 75-foot square basin for model tests on course stability and maneuvering characteristics of ships and submersibles; a 300-foot towing tank for high-speed testing; and an enclosed wind tunnel with 2.5 x 3.5 x 12-foot test section and with a maximum wind speed capability of 200 feet/second. Stevens has recently purchased and renovated a former luxury liner for use as a dormitory, permanently moored in the Hudson River immediately adjacent to the campus. A small oceanographic laboratory is being established aboard this ship. A 26-foot catamaran is also available for field work in the adjacent rivers and bays.

The following degrees are offered:

1. Doctor of Philosophy. The program leading to the Ph.D. degree is designed to develop the student's capability to perform basic research or high-level design in ocean engineering. All students entering the doctoral program must have a master's degree or equivalent. Students who have not earned their master's degrees in the Department of Ocean Engineering must take all the courses required for the Master of Engineering (Ocean) degree or must have satisfactorily completed comparable courses in other institutions. In addition to having completed the above requirements, all doctoral candidates must pass the qualifying examination which includes not only an oral examination to test the student's capability for advanced study, but also an evaluation of his ability to write effectively. The student may demonstrate writing ability by

presenting either an acceptable master's thesis or a critical review of several technical articles dealing with some aspect of ocean engineering. Doctoral candidates are expected to concentrate their advanced graduate studies in one of the areas of specialization presently offered in the department: Free Structures in the Ocean; Fixed Structures in the Ocean; or Underwater Acoustics. A fourth area, Pollution Control, is under development. Additional courses in the Department of Electrical Engineering, Mathematics and Mechanical Engineering are taken by the student to complete his program. Degrees granted (1972), one.

2. Master of Engineering (Ocean). A program of study leading to a master's degree should contain at least eight courses in ocean engineering. Five courses, which are considered basic to all areas within this field of study, are OE 101, OE 102, OE 103, OE 200 and OE 203. The remaining credits required for the master's degree can be obtained by either taking additional course work in a particular area of concentration or by additional course work and writing a master's thesis. Degrees granted (1972), 9.

The following courses are offered in conjunction with the above programs:

GRADUATE COURSES

OCEAN ENGINEERING

OE 101	Oceanography I	2.5
OE 102	Oceanography II	2.5
OE 103	Seminar in Ocean Engineering	2.5
OE 105	Transducers	2.5
OE 125	Principles of Naval Architecture	2.5
OE 127	Laboratory in Naval Architecture	2.5
OE 141	Acoustics	2.5
OE 143	Acoustics Laboratory	2.5
OE 150	Stochastic Marine Processes	2.5
OE 200	Fluid Dynamics for Ocean Engineering	2.5
OE 201	Theoretical and Applied Hydrodynamics	2.5
OE 203	Dynamic Oceanography	2.5
OE 220	Dynamics of Ocean Waves	2.5
OE 221	Motion of Vessels in Waves	2.5
OE 222	Stability and Control of Marine Craft	2.5
OE 223	Design of Marine Propulsors	2.5
OE 224	Hydrodynamics of High-Speed Marine Craft	2.5
OE 231	Vibrational Response to Ocean Structures	2.5
OE 240	Underwater Acoustics I	2.5
OE 242	Air-Sea Interactions: Theory and Measurements	2.5
OE 243	Special Topics in Ocean Instrumentation	2.5
OE 244	Acoustic Signal Processing	2.5
OE 246	Underwater Acoustics II	2.5
OE 248	Acoustics of Structures and Vehicles	2.5
OE 250	Optimal Control for Marine Systems	2.5
OE 251	Optimal Estimation for Ocean Engineers	2.5
OE 400	Special Problems in Ocean Engineering	1-3
OE 401	Special Problems in Ocean Engineering	1-2
OE 500	Thesis in Ocean Engineering	5
OE 600	Research in Ocean Engineering	to be arranged

MECHANICAL ENGINEERING

ME 274	Fluid Dynamics	2.5
ME 278	Viscous and Turbulent Flows	2.5

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF OCEAN ENGINEERING

Arase, Elizabeth M., Ph.D., Associate Professor
Arase, Tetsuo, Ph.D., Associate Professor
Breslin, John P., D.Sc., Chairman and Professor
Eda, Haruzo, D.Sc., Research Associate Professor
Henry, Charles J., D.Sc., Research Associate Professor
Hires, Richard I., Ph.D., Associate Professor
Kim, Cheung Hun, Dr. Ing., Research Associate Prof.
Mercier, John A., M.S., Visiting Lecturer
Numata, Edward, M.S., Research Associate Professor
Savitsky, Daniel, Ph.D., Associate Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Nickerson, Richard J., D.Sc., Professor

To obtain further information, address all inquiries directly to:

Dr. Richard I. Hires
Department of Ocean Engineering
Stevens Institute of Technology
Castle Point Station
Hoboken, New Jersey 07030

SUFFOLK COUNTY COMMUNITY COLLEGE
Selden, Long Island, New York 11784

In addition to normal chemistry and biology laboratories, the following are used in teaching marine technology: a Boston Whaler, a marine laboratory equipped with modern equipment, a 50-acre marine study area with two buildings, and the use of a campus computer center.

The fundamental goal of the program is to provide qualified high school graduates with two years of coordinated technical and general education courses at the college level in order to enable them to function as technicians in marine biology laboratories, conservation agencies, commercial fishing, seafood processing and allied marine industries. A graduate of this program receives an Associate in Applied Science degree and is prepared to assume the duties of a marine technician.

The following courses are offered in conjunction with the above program:

MR 24	Elements of Oceanography	4
MR 26	Commercial Fishing, Navigation and Seamanship	4
MR 30	Marine Ichthyology	4
MR 38	Fundamentals of Mariculture	3
MR 44	Commercial Marine Products	2
MR 45	Elements of Marine Ecology	4
ET 10	Environmental Problems of Pollution	2
ET 30	Biology and Water Pollution	3
CH 25, 26	General and Analytical Chemistry	8
BY 33, 34	Modern Biology I	8

The instructional staff for the courses listed above consists of the following:

Black, John A., B.A., Instructor
Kirchner, Carl, Ph.D., Professor
Sherrill, Edwin L., A.A., Technical Assistant
Smith, Walter L., M.S, Professor and Head of Department of Marine Science and Technology
White, Harry H., Technical Assistant

To obtain further information, address all inquiries directly to:

Walter L. Smith, Professor
Head of Department of Marine Science and Technology
Suffolk County Community College
Selden, Long Island, New York 11784

SUFFOLK UNIVERSITY
41 Temple Street
Boston, Massachusetts 02114

The university offers course work in the marine sciences at its Boston location and at the marine field station at Edmunds, Maine. The main campus has laboratory facilities which have been modernized and expanded through renovation of pre-existing facilities. The renovation has provided new facilities in the form of an environmental room for maintaining marine organisms, Atomic Energy Commission-licensed facilities for radiobiological studies and additional laboratories for marine and non-marine studies.

The Edmunds, Maine facility is presently under development as a 40-acre waterfront facility on Cobscook Bay. An all-purpose building has been constructed to house kitchen and lavatory facilities used in support of activities associated with camping. The building has a stockroom, a conference and a seminar area, and a classroom-laboratory component which are utilized principally during inclement weather. Additional facilities include two house trailers converted to laboratories, an outdoor circulating seawater system and seven cabins used for camping. The New Hampshire Colleges and University Council-Suffolk University consortium for marine sciences is cooperating in the development and use of this station. The purposes of the station are to serve undergraduate and teacher education interest.

Suffolk University offers three degree programs which allow for course work in the marine sciences: B.A., B.S. and M.A. in Education. These programs are mostly identified with the biology curriculum and to a large extent with teachers in-service as science teachers. No degrees are offered in oceanography or marine sciences, but a program does exist in environmental technology (marine) within the biology major.

The following courses are offered in conjunction with the above degree programs:

UNDERGRADUATE

Bio	1.7	Underwater Collecting Technique	1
Sci	2.1	Introduction to Marine Science	4
Sci	2.2	Environmental Technology	12
Bio	2.5	Cryptogamic Botany	4
Bio	3.5	Ecology	4
Bio	3.51	Field Ecology	4
Bio	3.7	Marine Botany	4
Bio	3.9	Physiological Ecology	4
Bio	4.1	General Physiology	4
Bio	4.2	General Physiology	4
Bio	4.3	Invertebrate Zoology	4
Bio	4.4	Invertebrate Zoology	4
MSci	2.11	Marine Ecology	4
MSci	2.12	Marine Geology	4
MSci	2.13	Marine Chemistry	4

UNDERGRADUATE/GRADUATE

Bio	3.3	Parasitology	4
Bio	4.8	Natural History of Marine Plants	4
Bio	4.9	Natural History of Marine Invertebrates	4
Bio	5	Seminar	1-2
Bio	10	Directed Studies	3-4

GRADUATE

Bio	S6.0	Biology of Marine Organisms	6

The instructional staff for the courses listed above consists of the following:

Comeau, Gerald, A.S., Lecturer in Biology
Fiore, James, Ph.D., Assistant Professor of Biology
Friedman, Robert S., Ph.D., Professor of Biology
Mulvey, Phillip F., Jr., Ph.D., Professor of Biology
Romach, Eileen, Ph.D., Assistant Professor of Biology
Snow, Beatrice L., Ph.D., Chairman and Associate Professor of Biology
West, Arthur J., II, Ph.D., Professor of Biology and Director of Marine Station

Special lecturers in the marine science courses include:
Burns, Richard, Ph.D., Assistant Professor of Biology
Loop, Taylor, M.S., Assistant Professor of Geology

Special Guest Lecturers in the graduate course include:
Gerachi, Joseph R., Ph.D., Marine Vertebrates
Lamb, I. MacKenzie, D.Sc., Marine Algology
Sherman, Kenneth A., M.S., Biological Oceanography
Simon, Joseph L., Ph.D., Marine Invertebrates

To obtain further information, address all inquiries directly to:

Mr. William F. Coughlin
Director of Admissions
Suffolk University
41 Temple Street
Boston, Massachusetts 02114

THE UNIVERSITY OF TEXAS
Austin, Texas 78712

The university offers courses in marine studies at both its main campus at Austin and its Marine Science Institute at Port Aransas, Texas, 30 miles northwest of Corpus Christi. The institute occupies buildings at the northern tip of Mustang Island with access to bays, beaches and the open Gulf of Mexico. Environments readily accessible include the hypersaline Laguna Madre, oyster reefs, underwater grass flats, rock jetties, shallow bays, tidal inlets, beaches and the continental shelf.

The institute has a large air-conditioned laboratory building which includes library, classrooms, isotope facilities, shops and garages. Special facilities include three walk-in controlled light and temperature rooms, a mass spectrometer for stable isotope studies, autoclave room, a storage and handling room for radioisotopes, dark rooms and drafting space. A wide variety of laboratory equipment and supplies is available for research and teaching. The library includes about 2,000 books and 5,000 journal volumes in marine science and related fields. There are large collections of reprints, documents and maps of the area.

A separate air-conditioned building houses a vibration free physiological laboratory and a pier laboratory is located in the Aransas Pass inlet. These two laboratories are provided with running seawater. Twenty outdoor experimental ponds and a salinity gradient table with filtered or raw seawater are available. The institute provides the new air-conditioned 82-foot steel boat, Longhorn, the 44-foot trawler Lorene, a 40-foot self-propelled barge, several smaller boats and related equipment in addition to an assortment of vehicles for field use. The 5.25-acre modern boat basin immediately adjacent to the institute provides docking space for institute vessels. Separate dormitory facilities for men and women are available.

A $3 million institute expansion program is to be completed in the spring of 1974. It will provide a new office/laboratory building of 60,000 square feet including complete running seawater facilities for one-third of the floor

space, a physical plant building of 10,000 square feet, more dormitories for single students, and an eight-unit apartment complex for married students. The new physical plant building will also permit conversion of most of the existing main building's first floor to additional laboratory space. The new facility will provide aquarium and water research capabilities for behavioral, physics, physiology and chemical programs.

Master of Arts and Doctor of Philosophy programs in biological, physical or earth sciences may be concentrated in the area of marine science. Marine science and related courses listed in the various Austin campus science departments may be used as supporting work for marine science programs.

M.A. in biological sciences (botany and zoology), chemistry, geology or microbiology with work concentrated in marine science. Nine to 12 hours of marine science as the minor may be combined with 12 to 15 hours of the major and six hours of thesis registration for a total of 30 hours. There is no language requirement for the master's degree in most of the related departments except geology. The program of study and the thesis are approved by a supervisory committee appointed by the dean.

Ph.D. in biological sciences (botany and zoology), chemistry, geology or microbiology with work concentrated in marine science. Requirements and examinations for admission to candidacy vary according to the specifications of the graduate faculty of the major department of Austin. German, french or russian is generally used to fulfill the language requirement of the Graduate School. A second language is part of the degree requirement in most of the related science departments. There is no set number of course hours required. The program of study, languages, final oral examination and doctoral dissertation are approved by a supervisory committee and the dean.

Degrees granted during the past academic year are as follows: M.A. in Chemistry, one; M.A. in Zoology, two; Ph.D. in Chemistry, four; Ph.D. in Zoology, one; and Ph.D. in Botany, two.

Courses in marine studies are offered during the regular long session at the Austin campus by the Departments of Zoology, Chemistry, Civil Engineering (including Meteorology), Botany and Microbiology. The Marine Science Institute offers regular summer courses and thesis research or special problem courses all year long at Port Aransas.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

(Courses offered at Port Aransas)

Mn. S. 641	General Marine Science	6
Mn. S. 352.1	Marine Invertebrates	3
Mn. S. 352.2	General Marine Microbiology	3
Mn. S. 352.3	Marine Geology	3
Mn. S. 352.4	Biology of the Microalgae	3
Mn. S. 352.5.3	Ecology of Fishes	3
Mn. S. 352.6	Marine Chemistry	3
Mn. S. 362.7	Structure and Function of Marine Animals	3
Mn. S. 352.8	Estuarine Ecology	3
Mn. S. 352.9	Endocrinology	3
Mn. S. 352.10	Physical Oceanography	3
Mn. S. 352.11	Marine Meteorology	3
Mn. S. 352.12	Adaptive Physiology of Marine Organisms	3
Mn. S. 353.1	Topics in Marine Science: Biogeochemistry of Carbon	3

DEPARTMENT OF CIVIL ENGINEERING

CE 376	Physical Oceanography	3
CE 377K	Introductory Ocean Engineering	3

DEPARTMENT OF GEOGRAPHY

GRG 364	Oceanography	3

DEPARTMENT OF GEOLOGY

GEO 307	Introduction to Oceanography	3
GEO 367K	Oceanography	3

DEPARTMENT OF ZOOLOGY

ZOO 440	Limnology and Oceanography	4

GRADUATE

(Courses offered at Port Aransas)

Mn. S. 680	Research in Marine Science	--
Mn. S. 680.1	Marine Invertebrates	6
Mn. S. 680.2	Marine Microbial Ecology	6
Mn. S. 680.3	Marine Geology	6
Mn. S. 680.4	Biology of the Microalgae	6
Mn. S. 680.5.3	Ecology of Fishes	6
Mn. S. 680.6	Marine Chemistry	6
Mn. S. 680.7	Structure and Function of Marine Animals	6
Mn. S. 680.8	Estuarine Ecology	6
Mn. S. 680.9	Endocrinology	6
Mn. S. 680.10	Physical Oceanography	6
Mn. S. 680.11	Marine Meteorology	6
Mn. S. 382.1	Marine Invertebrates	3
Mn. S. 382.2	Marine Microbial Ecology	3
Mn. S. 382.3	Marine Geology	3
Mn. S. 382.4	Biology of the Microalgae	3
Mn. S. 382.5.3	Ecology of Fishes	3
Mn. S. 382.6	Marine Chemistry	3
Mn. S. 382.7	Structure and Function of Marine Animals	3
Mn. S. 382.8	Estuarine Ecology	3
Mn. S. 382.9	Endocrinology	3
Mn. S. 382.10	Physical Oceanography	3
Mn. S. 382.11	Marine Meteorology	3
Mn. S. 382.12	Adaptive Physiology of Marine Organisms	3
Mn. S. 389K	Physiological Phycology	3
Mn. S. 690	General Marine Science	6

DEPARTMENT OF BOTANY

BOT 392M	Marine Phycology	3
BOT 389K	Physiological Phycology	3

DEPARTMENT OF CHEMISTRY

CH 385K	Topics in Geochemistry	3

DEPARTMENT OF CIVIL ENGINEERING

CE 380P.1	Ocean Waves and Tides	3
CE 380P.2	Coastal Engineering	3
CE 380P.3	Estuarine Engineering	3
CE 380P.4	Functional Design of Coastal Structures	3
CE 385K.2	Stream and Estuarine Analysis	3
CE 397	Stream and Estuarine Analysis II	3
CE 397	Ocean Engineering Problems	3

DEPARTMENT OF ZOOLOGY

ZOO 388L	Physiology of Marine Animals	3
ZOO 384L.4	Ichthyology	3

The instructional staff for the courses listed above consists of the following:

BOTANY

Van Baalen, C., Ph.D., Professor
Wynne, M.J., Ph.D., Associate Professor

CHEMISTRY

Parker, P. L., Ph. D., Associate Professor

CIVIL ENGINEERING

Armstrong, Neal E., Ph. D., Associate Professor of Ocean Engineering
Dailey, James, Ph. D., Assistant Professor of Ocean Engineering
Masch, Frank D., Ph. D., Professor of Civil Engineering
Smith, N., Ph. D., Assistant Professor of Civil Engineering

GEOLOGY

Behrens, E. W., Ph. D., Associate Professor

GEOGRAPHY

Brand, D. D., Ph. D., Professor

MICROBIOLOGY

Oppenheimer, C. H., Ph. D., Professor

ZOOLOGY

Bittner, G. D., Ph. D., Assistant Professor
Hubbs, Clark, Ph. D., Professor
Maguire, Bassett, Jr., Ph. D., Associate Professor
Nicol, J. A. C., D. Phil., D. Sc., Professor
Sage, M., Ph. D., Associate Professor
Wohlschlag, D. E., Ph. D., Professor

To obtain further information, direct all inquiries to:

Director
The University of Texas Marine Science Institute
Port Aransas, Texas 78373

The College of Engineering laboratories are well-equipped for ocean engineering research. Modern facilities and instrumentation are available for work in ocean hydrodynamics, structures, soils, saline water conversion, underwater acoustics and nuclear engineering. Numerous supporting laboratories are also available throughout the college.

The university offers the following degrees:

Master of Science in Engineering. The program leading to the degree of M. S. is not fixed but is developed in conferences between the student, the graduate faculty of the department in which the student elects to receive his degree, and a member of the ocean engineering committee. Administrative procedures are handled through the graduate advisor of the department. The M. S. degree requires at least 30 semester hours of work beyond the B. S. degree, six hours of which are usually for a thesis.

Doctor of Philosophy in Engineering. The program leading to the degree of Ph. D. is worked out between the student, a member of the ocean engineering committee and the departmental Committee on Graduate Studies. Students seeking this degree are expected to have well-developed ideas about their goals in graduate study, and to a large extent the Ph. D. program is adjusted to the student's interests consistent with general requirements of the university.

The ocean engineering program at The University of Texas at Austin is interdisciplinary and combines a basic knowledge of the ocean with engineering specialties for the utilization of the resources of the sea and its boundary. The program is based on a number of core courses with specific coastal and marine applications and supporting work with application to oceanic systems. Study in ocean engineering provides a balanced program including course work, individual study and research. By electing courses from across departmental lines, individual programs can be set up in areas such as coastal and estuarine engineering, foundations and construction, mechanical and thermal systems, acoustics, communications and control systems, and ocean resources.

Courses in ocean engineering are offered during the regular year at the main campus by the Departments of Aerospace and Engineering Mechanics, Chemical, Civil, Electrical, Mechanical and Petroleum Engineering. Courses are also available at the university's Institute of Marine Science at Port Aransas, Texas. A college-wide committee coordinates ocean engineering activities at the university and is available for advising students with their programs.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF AEROSPACE ENGINEERING AND ENGINEERING MECHANICS

UNDERGRADUATE

CHE 365	Water Treatment Engineering: Corrosion

GRADUATE

CHE 681M	Transport Operations

DEPARTMENT OF CIVIL ENGINEERING

UNDERGRADUATE

CE 377K. 21	Introductory Ocean Engineering
MET 376	Physical Oceanography

GRADUATE

CE 380P. 1	Ocean Waves and Tides
CE 380P. 2	Coastal Engineering
CE 380P. 3	Estuarine Engineering
CE 380P. 4	Functional Design of Coastal Structures
CE 385K. 1	Water Resources - Properties, Supply and Treatment
CE 385K. 2	Water Resources - Stream and Estuarine Analysis
CE 394. 1	Interaction of Soils and Structures - Selected Problems
CE 394. 2	Interaction of Soils and Structures - Methods of Analysis
CE 397. 22	Special Studies in Ocean Engineering
CE 397. 52	Marine Science for Engineers
CE 397. 172	Marine and Water Transportation

DEPARTMENT OF ELECTRICAL ENGINEERING

UNDERGRADUATE

EE 379. 14	Introduction to Engineering Acoustics

GRADUATE

EE 381J	Random Processes in Physical Systems
EE 384L. 1	Waves in Material Media
EE 384L. 2	Electrical Geophysics
EE 397K. 32	Engineering Acoustics

DEPARTMENT OF MECHANICAL ENGINEERING

UNDERGRADUATE

ME 379M. 14	Problems in Ocean Engineering

GRADUATE

ME 385Q. 2	Engineering Acoustics - Acoustical Field Theory

ME 385Q.3	Engineering Acoustics - Ocean Sound Propagation
ME 385Q.4	Engineering Acoustics - Underwater Signaling
ME 389Q.4	Similitude and Model Design

DEPARTMENT OF PETROLEUM ENGINEERING

GRADUATE

PE 383.2	Advanced Well-logging and Correlation
PE 383.4	Offshore Drilling and Production Operations
PE 383.6	Rock Mechanics I
PE 383.8	Rock Mechanics II

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF AEROSPACE ENGINEERING AND ENGINEERING MECHANICS

Bertin, J.J., Ph.D., Associate Professor
Hickox, C.E., Ph.D., Assistant Professor
Mack, L.R., Ph.D., Associate Professor
Tapley, B.D., Ph.D., Professor and Chairman

DEPARTMENT OF CHEMICAL ENGINEERING

Brock, J.R., Ph.D., Professor
Wissler, E.H., Ph.D., Professor

DEPARTMENT OF CIVIL ENGINEERING

Armstrong, N.E., Ph.D., Associate Professor
Dailey, J.E., Ph.D., Assistant Professor
Fruh, E.G., Ph.D., Associate Professor
Gloyna, E.F., Dr. Eng., Dean, Professor and Director, Center for Research in Water Resources
Jehn, K.H., M.S., Professor and Director, Atmospheric Science
Koschmieder, E.L., Dr. Rer. Nat., Associate Professor
Malina, J.F., Ph.D., Professor and Director, Environmental Health Engineering Laboratories
Masch, F.D., Ph.D., Professor
Matlock, H., M.S., Chairman and Professor
Moore, W.L., Ph.D., Professor
Reese, L.C., Ph.D., Professor
Smith, N., Ph.D., Assistant Professor
Wagner, N.K., Ph.D., Associate Professor
Walton, C.M., Ph.D., Assistant Professor
Wright, S.G., Ph.D., Assistant Professor

DEPARTMENT OF ELECTRICAL ENGINEERING

Bostick, F.X., Ph.D., Professor
Gregg, W.D., Ph.D., Associate Professor
Hixson, E.L., Ph.D., Professor
Straiton, A.W., Ph.D., Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Carter, W.J., Ph.D., Professor
Helfinstine, R.A., Ph.D., Assistant Professor
Schmidt, P.S., Ph.D., Assistant Professor

DEPARTMENT OF PETROLEUM ENGINEERING

Gray, K.E., Ph.D., Chairman and Professor
Jessen, F.W., Ph.D., Professor
Pirson, S.J., D.Sc., Professor

To obtain further information, address all inquiries directly to:

Dr. James E. Dailey
Department of Civil Engineering
The University of Texas at Austin
Austin, Texas 78712

THE UNIVERSITY OF TEXAS
THE MARINE BIOMEDICAL INSTITUTE
Galveston, Texas 77550

The Marine Biomedical Institute (MBI) is a major unit of the University of Texas Medical Branch (UTMB), Galveston, Texas. Its activities are housed in approximately 70,000 square feet of space on the University of Texas Medical Branch campus and in the Sealy-Smith Professional Building. Representatives from the following sponsoring institutions make up a coordinating committee which advises the director regarding the formulation of the Marine Biomedical Institute's programs: The University of Texas Medical School at San Antonio; Lamar University, Beaumont; The University of Texas Southwestern Medical School at Dallas; Galveston College; Brazosport Junior College; University of Houston; College of the Mainland, Texas City; University of Texas at Austin; Rice University, Houston; and Texas Technological University, Lubbock.

The institute offers doctoral and post-doctoral training in the marine biomedical sciences to selected students. Degrees are conferred by the sponsoring institutions upon satisfactorily meeting their requirements. No formal courses are offered. Graduate training is given according to the individual requirements of the student and comensurate with the academic requirements of the sponsoring institution.

The facilities also include a 135-foot research vessel, the Miss Freeport, equipped to support 24 diver-scientists in open ocean and the PC-8, a Perry submarine capable of accommodating two observers and an operator for sustained operations at depths to 1,000 feet.

The institute's activities include programs in comparative neurobiology, cardiovascular control, biomedical engineering, marine biochemistry, programs in earth and the planetary sciences and the Flower Gardens Ocean Research Center. Plans are being made for the erection of a fixed platform above the surface of the water on a coral reef in the Gulf of Mexico adjacent to Galveston Island. Extensive research is being conducted on the coral reef at the present time using the Miss Freeport.

The instruction staff consists of:

Wolf, Stewart, M.D., Director of MBI; University of Texas System Professor of Medicine; Professor of Medicine and of Physiology, The University of Texas Medical Branch at Galveston.

COMPARATIVE NEUROBIOLOGY DIVISION

Blankenship, James, Ph.D., Assistant Professor of Physiology, UTMB
Coggeshall, Richard E., M.D., Chief, Ultrastructure Section, MBI; Professor of Anatomy, UTMB
Feinstein, Robert, Ph.D., Assistant Professor of Bioengineering (Physiology), UTMB
Haber, Bernard, Ph.D., Chief, Biochemistry Section, MBI; Associate Professor of Biochemistry, UTMB
Kittredge, James S., Ph.D., Chief, Comparative Marine Biochemistry and Pharmacology Section, MBI; Professor of Biochemistry, UTMB

Pinsker, Harold, Ph. D., Assistant Professor of Physiology, UTMB

Stone, H. Lowell, Ph. D., Chief, Cardiovascular Control Section, MBI; Research Professor of Physiology, UTMB

Suttle, Andrew D., Jr., Ph. D., Professor of Nuclear Chemistry and Biophysics (Radiology), UTMB

Willis, William D., Jr., M. D., Ph. D., Chief, Comparative Neurobiology Division, MBI; Professor of Physiology and Anatomy, UTMB

EARTH AND PLANETARY SCIENCES DIVISION

Dorman, James, Ph. D., Professor of Geophysics, UTMB

Ewing, Maurice, Ph. D., Chief, Earth and Planetary Sciences Division, MBI; Professor of Geosciences, UTMB

Latham, Gary V., Ph. D., Professor of Geophysics, UTMB

Matumoto, Tosimatu, Ph. D., Senior Research Scientist, UTMB

Nakamura, Yosio, Ph.D., Senior Reseach Scientist, UTMB

Watkins, Joel, Ph. D., Professor of Geophysics, UTMB

Worzel, J. Lamar, Ph. D., Deputy Chief, Earth and Planetary Sciences Division, MBI; Professor of Geophysics, UTMB

FLOWER GARDENS OCEAN RESEARCH CENTER

Alderice, J. Robert
Bowman, Dennis
Covington, James O.

TEXAS A & M UNIVERSITY
College Station, Texas 77843

Texas A & M University's major marine facilities are located on the main campus at College Station and at the Mitchell Campus and Fort Crockett in Galveston.

The university's Departments of Oceanography and Meteorology are housed in a new 12-story building on the main campus. This well-equipped teaching and research complex is complemented by a staging and docking facility at the Mitchell Campus on Pelican Island, Galveston. The Oceanography Department operates the 180-foot research vessel R/V Alaminos, the 36-foot R/V La Mer II and the 110-foot R/V Kasidah. Texas A & M University has been selected to receive a new $3.5 million oceanography research vessel to be built for the Navy. The new vessel, 165 feet long and accommodating 28 persons, is expected by winter, 1974.

A new wing to the Biological Sciences Building provides additional laboratory facilities for biology and wildlife and fisheries sciences. Cooperative programs exist to provide field laboratories for students and faculty. For example, the Department of Fisheries and Wildlife Sciences is working with Houston Lighting and Power Co. to study problems associated with new and existing power generating plants.

The Environmental Engineering Division of the Civil Engineering Department carries out a broad teaching and research program with particular emphasis in estuarine water quality. The division operates a field laboratory on Galveston Bay and facilities at the Water Reclamation Center in Dallas. A well-equipped laboratory on the College Station campus supports the field programs. The division operates three research vessels which dock at the field laboratory. The 56-foot R/V Excellence, the 62-foot R/V Duet and the 50-foot R/V Mariner.

The division's research program includes analytical water quality models for coastal and estuarine areas, evaluation of pollutant and quality parameter mass balances in coastal aquatic systems, water quality management methods, reaeration, hazardous materials control, advanced waste treatment and water reclamation.

The Hydromechanics Laboratory of the Coastal and Ocean Engineering Division of Civil Engineering was established in February, 1969, to study the major Gulf Coast bays and estuaries. The laboratory has facilities for research and teaching, including large, equipped wave tanks, wave-sediment basins, recirculating flumes and wave/current flumes.

The Center for Dredging Studies was established in June, 1968, in response to renewed interest in greater utilization and exploitation of minerals from the ocean floor and increased dredging activities in estuaries and offshore.

The Mitchell Campus of the Moody College of Marine Sciences and Maritime Resources occupies 100 acres of land on Pelican Island in Galveston Bay. Current facilities include two new buildings, a staging and storage facility for the Department of Oceanography, and wharfage for the 473-foot, 15,000-ton, Texas Maritime Academy training ship T/S Texas Clipper as well as the fleet of Texas A & M oceanographic vessels. An $8 million building program will include a dormitory-dining facility, a library building and a marine sciences teaching and research complex.

Vessels available at the Moody College for student training and research are the 30-foot Cheetah and the 30-foot Mayoureen.

The Fort Crockett portion of the Moody College is located on Galveston Island on one-and-one-half acres of land and provides 56,000 square feet of space in a three-story building for research and teaching in the Department of Marine Sciences.

The following degrees are offered (degrees granted in parenthesis):

B.S. in Marine Sciences (Proposed). This degree program is oriented toward the student who desires a solid education in marine sciences that is general in approach and field-oriented. Option programs to provide specialization in fisheries and marine biology are in preparation.

All Marine Science majors must take 29 required science and mathematic courses as prerequisites. Also required are 24 semester hours in the humanities and social sciences as well as 12 hours of electives.

B.S. in Marine Transportation. The license-oriented academic programs consist of two semesters for four years and three summer training cruises. The cruises are about 10 weeks in duration and are taken aboard the T/S Texas Clipper, a former passenger-cargo liner, 473-feet long and 15,000 tons, provided by the Maritime Administration. Classes are conducted aboard ship, and each student performs duties which supplement theoretical studies ashore.

The Texas Maritime Academy entered its first class in 1962, as the fifth state maritime academy of the United States. Departments in the Texas Maritime Academy rely heavily on the activities of the Galveston, Houston and Texas City port areas as laboratory and technical teaching environments to supplement classroom work.

Two degree courses of study are offered--Marine Engineering and Marine Transportation. Each degree plan consists of four years of college and professional education.

Upon successful completion of the course of study and three training cruises, the license-option graduate receives a Bachelor of Science degree from Texas A & M University in marine engineering or marine transportation. In the license option the degree qualifies the graduate to take the U. S. Coast Guard examination for third mate or third assistant engineer in the U. S. Merchant Marine. Graduates, where qualified, also earn a commission as ensign, U. S. Naval Reserve.

The Department of Marine Engineering offers a pro-

gram in theoretical and applied engineering technology related to the design and operation of shipboard and offshore engineering power and auxiliary systems. The Department of Marine Transportation presents curricula and instruction leading to an understanding of seaborne commerce and traffic, with an emphasis on the safe navigation of the vessel, logistic requirements, communication, cargo handling and seamanship. (14)

M.S. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students who are candidates for an M.S. degree are required to obtain practical experience in some phase of marine biology and to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of course work, eight of which will be credited for successfully completing an acceptable research thesis. (3)

Ph.D. in Biology, Botany, Microbiology or Zoology (marine emphasis). Students are required to obtain practical research experience in areas of marine emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. (B.A.) or 64 semester hours beyond an M.S. (M.A.). To qualify for the preliminary examination, the student must satisfy the language work, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (4)

M.E. in Civil Engineering with a program in coastal and ocean engineering or environmental engineering. The Master of Engineering degree requires a minimum of 36 semester hours of which one third is taken in fields other than the major field. A thesis is not required. With these exceptions, requirements are the same as those for the Master of Science degree. (3)

M.S. in Civil Engineering with a program in coastal and ocean engineering or environmental engineering. The Master of Science degree program requires a minimum of two full semesters of approved courses and research (32 semester hours). This requirement is ordinarily met by completing at least 24 hours of course work and up to eight hours of research. A thesis embodying original work is required. The student is required to pass a final examination, covering his graduate programs, which is administered by the student's graduate committee and may be either written or oral. (9)

Ph.D. in Civil Engineering with a program in coastal and ocean engineering or environmental engineering. The doctoral degree program requires a minimum of six full semesters of acceptable advanced study (96 hours of research and formal courses above a bachelor's degree). To qualify for the preliminary examination, the student must have completed all but approximately six hours of the formal course work on his degree program excluding dissertation research credits. The examination is both oral and written unless otherwise recommended and approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (9)

B.S. in Wildlife and Fisheries Sciences with an option in wildlife ecology - natural history, fisheries ecology - aquaculture or teaching - museum science. Entering freshmen enroll in a program of two semesters of basic courses. At the beginning of the sophomore year, the student selects one of the three options. The junior and senior years are oriented toward specialization in the option selected.

Emphasis is on programs which are designed to train individuals in the science of wildlife and fishery management and ecology, aquaculture and mariculture; for research in the ecology, systematics, zoogeography and general science, conservation of natural resources, biology, and zoology, and for positions as exhibit specialists, curators and allied work in museums and nature centers. (56)

M. Agr. in Fisheries Science or Wildlife Science. Approximately 12 of the 36 required credit hours are taken outside the student's option. Each candidate is normally required to prepare one or more written reports in addition to papers required as part of regular course work. The reports are expected to be of a scholarly nature and may carry up to four hours of credit. (5)

M.S. in Fisheries Science or Wildlife Science. Students who are candidates for an M.S. degree are required to obtain practical experience in some phase of wildlife or fisheries science and to demonstrate competence by satisfactorily completing a comprehensive examination and a thesis project. Each student is required to satisfactorily complete 32 hours of course work, eight of which will be credited for successfully completing an acceptable research thesis. (12)

Ph.D. in Fisheries Science or Wildlife Science. Students are required to obtain practical research experience in areas of fisheries science or wildlife science emphasis. Though there are no absolute course requirements, each doctoral candidate is expected to complete at least 96 semester hours above a B.S. (B.A.) or 64 semester hours beyond an M.S. (M.A.). To qualify for the preliminary examination, the student must satisfy the language requirement and complete all but approximately six hours of his formal course work, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (3)

M.B.A. with specialization in marine resources management. For students with no undergraduate background in business administration the curriculum consists of 60 hours, 24 of which represent preprofessional course work. Undergraduate business majors may waive part or all of the latter. The student takes the core courses of the M.B.A. curriculum plus 15 hours of marine-oriented business courses described in the M.S. curriculum. In addition, he may elect three hours of course work in a marine-related discipline.

M.S. with specialization in marine resources management. The basic curriculum consists of 36 hours of course work. Of this 15 hours are in business administration subjects, focusing on various aspects of marine resources management. Fifteen hours consist of courses in one or more of the supporting disciplines. The remaining six hours involve an internship with a marine-oriented organization culminating in a thesis. Students with little or no prior knowledge in business administration subjects will be required to take six to nine hours of preparatory course work. Fifteen hours of course work in marine-related or other supporting disciplines are included.

M.S. in Oceanography. A minimum of two full semesters of approved courses and research (32 semester hours) are required for the Master of Science degree. Ordinarily the student devotes the major portion of this time to work in one field or two closely related fields. Other work is in supporting fields of interst. Generally, not less than one-third of the course work, excluding research, is taken in one or more fields outside the major field.

Specialization may be undertaken for both the M.S. and Ph.D. degrees in biological, chemical, geological, meteorological and physical oceanography. An effort is made to maintain a balance between the biological, chemical, geological and physical aspects of oceanography both in teaching and research. (10)

Ph.D. in Oceanography. To qualify for the preliminary examination, the student must have satisfied the language requirement and have completed all but approximately six hours of the formal course work on his degree program, excluding dissertation research credits. The examination is both oral and written unless otherwise recommended or approved. Following completion of the preliminary examination, the student pursues a dissertation problem to demonstrate his capability for independent research. (10)

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Bio	108	Invertebrate Zoology	3
Bio	113	Introductory Biology	3
Bio	114	Introductory Biology	3
Bio	123	Introductory Biology Laboratory	1
Bio	124	Introductory Biology Laboratory	1
Bio	330	Life Science	3
Bio	337	Organic Evolution	2
Bio	357	Invertebrate Ecology	4
Bio	408	Biology of the Algae	4
Bio	435	Advanced Invertebrate Zoology	4
Bio	436	Animal Parasitology	4
Bio	440	Marine Biology	4
Bio	459	Aquatic Biology	3
Bio	460	The Biology of Man's Environment	3
Bio	481	Seminar in Biology	1
Bio	482	Seminar in Biology	1
Bio	485	Biological Problems	1-4
Chem	383	Chemistry of Environmental Pollution	3
C. E	301	Water and Sewage Treatment	3
C. E.	311	Fluid Dynamics	4
C. E.	336	Fluid Dynamics Laboratory	1
C. E.	338	Water Resources Engineering	2
C. E.	402	Water Supply and Sewage Practice	3
C. E.	403	Sanitary Design	3
C. E.	406	Sanitation and Public Health	3
C. E.	458	Hydraulic Engineering	3
C. E.	462	Hydrodynamics	3
C. E.	463	Hydrology	3
C. E.	481	Seminar	1
C. E.	485	Problems	1-3
Geog.	210	Marine Geography	3
Geog.	315	Geography of the Sea	3
Geog.	320	Geography of the Pacific Basin	3
Geol.	205	Physical Geology	4
Geol.	206	Historical Geology	4
Geol.	305	Invertebrate Paleontology	3
Geol.	423	Micropaleontology	3
Geol.	441	Advanced Engineering Geology	4
Geop.	315	Evolution of Continents and Ocean Basins	3
Mar. E.	101	Engineering Analysis	1
Mar. E.	105	Engineering Mechanics I	3
Mar. E.	200	Basic Operations - Summer Cruise	4
Mar. E.	202	Introduction to Marine Operations	3
Mar. E.	206	Engineering Mechanics II	3
Mar. E.	207	Electricity and Magnetism	4
Mar. E.	209	Mechanics of Materials	3
Mar. E.	216	Kinematic Drawing	1
Mar. E.	219	Strength of Materials Laboratory	1
Mar. E.	300	Intermediate Operations - Summer Cruise	4
Mar. E.	301	Fluid Mechanics and Heat Transfer	3
Mar. E.	303	Marine Thermodynamics	3
Mar. E.	304	Marine Thermodynamics	3
Mar. E.	306	Marine Refrigeration and Air Conditioning	3
Mar. E.	307	Electrical Circuits	4
Mar. E.	308	Electrical Machinery	4
Mar. E.	310	Engineering Computation	3
Mar. E.	400	Advanced Operations - Summer Cruise	4
Mar. E.	401	Nuclear Propulsion I	3
Mar. E.	402	Diesel Engineering	3
Mar. E.	403	Marine Steam and Gas Turbines	3
Mar. E.	405	Steam Generators	3
Mar. E.	408	Nuclear Propulsion II	3
Mar. E.	414	Ship Automation	4
Mar. E.	416	Engineering Laboratory I	1
Mar. E.	417	Engineering Laboratory II	1
Mar. E.	485	Problems	1-4
Mar. S.	310	Field Methods in Marine Sciences	3
Mar. S.	320	Coastal Zone Environments	3
Mar. S.	420	Marine Ecology	3
Mar. S.	435	Marine Invertebrate Zoology	4
Mar. S.	450	Developmental Biology of Marine Organisms	4
Mar. S.	481	Seminar	1
Mar. S.	485	Problems	1-6
Mar. T.	301	Ocean Transportation I	4
Mar. T.	302	Marine Cargo Operations I	3
Mar. T.	304	Ocean Transportation II	3
Mar. T.	321	Marine Law I	3
Mar. T.	402	Ocean Transportation III	3
Mar. T.	406	Marine Cargo Operations II	3
Mar. T.	421	Marine Law II	3
Mar. T.	485	Problems	1-4
Met.	203	Introduction to Weather and Climate	1
Met.	301	Atmospheric Science	3
Met.	302	Weather Reports and Forecasting	3
Met.	305	General Meteorology	3
Met.	324	Physical and Regional Climatology	3
Met.	445	Atmospheric Physical Processes	3
Met.	446	Physical Meteorology	3
Met.	463	Air Pollution Meteorology	3
Met.	467	Marine Meteorology	3
Met.	481	Seminar	1
Met.	485	Problems	1-3
Naut.	103	Nautical Orientation I	0
Naut.	104	Nautical Orientation II	0
Naut.	200	Basic Communications, Navigation & Seamanship	4
Naut.	201	Naval Architecture I	3
Naut.	202	Naval Architecture II	2
Naut.	203	Seamanship I	3
Naut.	204	Terrestrial Navigation	3
Naut.	300	Intermediate Communications, Navigation, and Seamanship	4
Naut.	301	Seamanship II	3
Naut.	302	Seamanship III	2
Naut.	303	Celestial Navigation	3
Naut.	304	Electronic Navigation	3
Naut.	400	Advanced Communications, Navigation and Seamanship	4
Naut.	401	Seamanship IV	3
Naut.	404	The Navigator	3
N. S.	101	Naval Orientation and Leadership	1
N. S.	102	Naval Ship Systems	1
N. S.	110	Naval Orientation	3
N. S.	112	Naval Ships Systems	3
N. S.	201	Seapower and Maritime Affairs I	1
N. S.	202	Seapower and Maritime Affairs II	1
N. S.	213	Seminar in Seapower and Maritime Affairs I	1
N. S.	214	Seminar in Seapower and Maritime Affairs II	1
N. S.	301	Navigation and Operations Analysis	3
N. S.	302	Navigation and Operations Analysis II	3
N. S.	303	Evolution of Warfare I	3
N. S.	304	Evolution of Warfare II	3
N. S.	315	Navigation	3
N. S.	316	Naval Operations Analysis	3
N. S.	401	Naval Weapons Systems	3
N. S.	402	Principles of Naval Organization and Management	3
N. S.	403	Amphibious Warfare I	3
N. S.	404	Amphibious Warfare II	3
N. S.	411	Naval Organization and Management	3
N. S.	412	Naval Weapons	3
O. E.	300	Dynamics of Waves and Structures	3
O. E.	400	Basic Coastal Engineering	3
O. E.	401	Measurements in the Ocean	4
Ocn.	205	Introduction to Ocean Studies	1
Ocn.	401	Introduction to Oceanography	3
Ocn.	403	Tides, Waves, Currents, Ice	3
Ocn.	410	Introduction to Physical Oceanography	2
Ocn.	420	Introduction to Biological Oceanography	2
Ocn.	430	Introduction to Geological Oceanography	2
Ocn.	440	Introduction to Chemical Oceanography	2
R. P.	301	Outdoor Recreation	3
R. P.	316	Wilderness Recreation Management	3
R. P.	375	Conservation of Natural Resources	3
R. P.	460	Development of Recreation Resources	3
Stat.	406	Statistical Methods	3
V. Mi.	406	Aquatic Animal Microbiology	4

V. Mi.	597	Viruses of Laboratory, Marine and Exotic Animals	3
V. Mi.	598	Introduction to Diseases of Food Fish	3
W. F. S.	304	Conservation and Management of Fishes	3
W. F. S.	311	Icthyology	3
W. F. S.	312	Icthyology	3
W. F. S.	400	Fisheries Survey	4
W. F. S.	403	Animal Ecology	3
W. F. S.	408	Techniques of Wildlife Management	3
W. F. S.	410	Conservation and Management of Fishes	3
W. F. S.	414	Limnology	3
W. F. S.	416	Animal Population Dynamics	3
W. F. S.	417	Biology of Fishes	3
W. F. S.	418	Fisheries Population Dynamics	3
W. F. S.	420	Ecology for Teachers	3
W. F. S.	423	Aquaculture	3
W. F. S.	485	Wildlife Problems	1-3

GRADUATE

An. Sc.	606	Microbiology of Foods	3
An. Sc.	608	Seafood Preservation and Processing	4
Arch.	601	Environmental Design	6
Arch.	602	Environmental Design	6
Arch.	613	Urban Design I	3
Arch.	614	Urban Design II	6
Arch.	615	Urban Design III	6
Arch.	616	Urban Design IV	6
Arch.	685	Problems	1-6
Biol.	608	Phycology	4
Biol.	612	Biology of Estuarine Organisms	3
Biol.	627	Helminthology	4
Biol.	630	Protozoology	4
Biol.	637	Marine Botany	4
Biol.	651	Mycology	4
Biol.	653	Zoogeography	3
Biol.	660	Aquatic Ecology	1
Biol.	662	Biology of the Mollusca	4
Biol.	663	Biology of the Crustacea	4
Biol.	665	Invertebrate Zoology	4
Biol.	667	Physiology of Host-Parasite Systems	3
Biol.	668	Biology of Invertebrate Symbioses	4
Biol.	681	Seminar	1
Biol.	685	Problems	1-6
Biol.	691	Research	1+
C. E.	603	Stream Quality	3
C. E.	605	Experimental Analysis in Environmental Engineering	3
C. E.	606	Design of Waste Water Treatment Systems	3
C. E.	609	Simulation of Water Resources Systems for Numerical Analysis	3
C. E.	610	Industrial Wastes	3
C. E.	611	Design of Potable and Industrial Water Systems	3
C. E.	627	Hydrology	3
C. E.	628	Hydraulic Engineering	3
C. E.	629	Hydraulics of Open Channels	3
C. E.	637	Pipeline Construction	2
C. E.	664	Water Resources Development	3
C. E.	675	Coastal Engineering I	3
C. E.	676	Ocean Engineering	3
C. E.	677	Coastal Engineering II	3
C. E.	678	Hydromechanics	3
C. E.	679	Theory of Fluid Mechanics Models	2
C. E.	680	Civil Engineering Computer Systems	3
C. E.	681	Seminar	1
C. E.	682	Coastal Sediment Processes	3
C. E.	683	Estuary Hydrodynamics	3
C. E.	685	Problems	1-6
C. E.	686	Offshore and Coastal Structures	3
C. E.	687	Marine Foundation Engineering	3
C. E.	688	Marine Dredging	3
C. E.	691	Research	1+
Econ.	621	Regional Science I	3
Econ.	622	Regional Science II	3
Econ.	624	Regional Income Accounting	3
Econ.	625	Regional Resource Management	3
Ento.	605	Aquatic Entomology	4
Fin.	670	Planning, Programming, Budgeting Systems	3
Geog.	610	Geography of Water Transport	3
Geog.	619	Man's Impact on His Environment	3
Geog.	620	Man and Nature	3
Geog.	626	River Basin Development	3
Geog.	627	Coastal Geomorphology	3
Geog.	641	Exploration and Discovery	3
Geog.	642	Exploration and Discovery II	3
Geol.	618	Sedimentation	3
Geol.	622	Stratigraphy	3
Geol.	650	Paleoecology	3
Geol.	662	Sedimentation	3
Geol.	681	Seminar	1
Geol.	685	Problems	1-6
Geol.	691	Research	1+
Geop.	604	Marine Geophysics	4
Mgmt.	661	Marine Resources Management	3
Mgmt.	662	Marine and Coastal Zone Law	3
Met.	625	Applied Climatology	3
Met.	645	Cloud and Precipitation Physics	3
Met.	656	Tropical Meteorology	3
Met.	665	Micrometeorology	3
Met.	676	Hydrometeorology	3
Met.	681	Seminar	2
Met.	685	Problems	1+
Met.	691	Research	1+
Ocn.	603	Sea Laboratory Techniques	1
Ocn.	608	Physical Oceanography	4
Ocn.	609	Physical Oceanography	3
Ocn.	611	Theoretical Physical Oceanography	3
Ocn.	614	Dynamics of the Ocean and Atmosphere	3
Ocn.	615	Long Waves and Tides	4
Ocn.	616	Theory of Ocean Waves	3
Ocn.	617	Theories of Ocean Circulation	3
Ocn.	618	Underwater Sound	3
Ocn.	620	Biological Oceanography	3
Ocn.	622	Analysis of Benthic Communities	3
Ocn.	623	Marine Zooplankton	3
Ocn.	624	Marine Phytoplankton	3
Ocn.	625	Deep-Sea Pelagic and Demersal Fishes	3
Ocn.	626	Organic Cycles of the Sea	3
Ocn.	631	Geological Oceanography	3
Ocn.	633	Carbonate Sediments I	2
Ocn.	634	Carbonate Sediments II	3
Ocn.	635	Techniques in Geological Oceanography	4
Ocn.	636	Marine Biostratigraphy I	3
Ocn.	637	Marine Biostratigraphy II	3
Ocn.	638	Simulation Techniques	4
Ocn.	639	Lithophycology	3
Ocn.	640	Chemical Oceanography	3
Ocn.	641	Chemical Oceanography	3
Ocn.	643	Geochemistry of the Ocean	3
Ocn.	644	Isotope Geochemistry	3
Ocn.	646	Quantitative Marine Biochemistry	3
Ocn.	651	Meteorological Oceanography	3
Ocn.	652	Ocean Boundary Layer Problems	3
Ocn.	653	Synoptic Physical Oceanography	3
Ocn.	681	Seminar I	1
Ocn.	682	Seminar II	1
Ocn.	685	Problems	1-4
Ocn.	691	Research	1+
Pol. S.	632	International Law	3
R. P.	650	Recreation Resource Development	3
V. M.	660	Diseases of Marine Invertebrates	4
V. M.	661	Diseases of Fish	4
W. F. S.	605	Systematic Icthyology	3
W. F. S.	609	Wildlife Research Methods	3
W. F. S.	611	Estuarine Ecology	4
W. F. S.	613	Field Studies of Shore and Estuarine Fishes of the Gulf of Mexico	4
W. F. S.	615	Mariculture	4
W. F. S.	681	Seminar	1
W. F. S.	685	Problems	2-6
W. F. S.	691	Research	1+

The instructional staff for the courses listed above consists of the following:

ANIMAL SCIENCE

Carpenter, Zerle L., Ph. D., Professor
Cobb, Bryant F. III, Ph. D., Associate Professor

ARCHITECTURE

Stogsdill, Russell L., M. Arch., Assistant Professor

BIOLOGY

Anderson, Jack W., Ph. D., Assistant Professor
Brown, Sidney O., Ph. D., Professor
Cox, Elenor R., Ph. D., Associate Professor
Dillon, Lawrence S., Ph. D., Professor
Fife, William P., Ph. D., Professor
Harry, Harold W., Ph. D., Associate Professor
Horvath, Kalman, Ph. D., Assistant Professor
Kleerekoper, Herman, Ph. D., Professor
Kuchnow, Karl, Ph. D., Assistant Professor
Sweet, Merrill H., Ph. D., Associate Professor
Taber, Willard A., Ph. D., Professor

CHEMISTRY

Glam, C. S., Ph. D., Associate Professor

CIVIL ENGINEERING

Allison, Richard C., Ph. D., Assistant Professor
Ball, John E., Ph. D., Assistant Professor
Basco, David R., Ph. D., Assistant Professor
Burnett, Neill C., Ph. D., Engineering Research Associate
Coyle, Harry M., Ph. D., Associate Professor
Dominguez, Richard F., Ph. D., Assistant Professor
Dunlap, Wayne A., Ph. D., Associate Professor
Hann, Roy W., Jr., Ph. D., Professor
Herbich, John B., Ph. D., Professor
Hughes, J. Martin, M. S., Assistant Professor
James, Wesley P., Ph. D., Assistant Professor
Lowery, L. L., Jr., Ph. D., Associate Professor
McCoy, Patrick T., Ph. D., Assistant Professor
Schiller, Robert E., Ph. D., Associate Professor
Sparr, Ted M., Ph. D., Assistant Professor
Wolf, Harold W., Ph. D., Professor
Woods, Calvin, Ph. D., Professor

DAIRY SCIENCE

Vanderzant, Carl, Ph. D., Professor

FINANCE

Etter, Wayne E., Ph. D., Associate Professor
Phillips, Clinton A., Ph. D., Professor and Head

GEOGRAPHY

Carter, George F., Ph. D., Professor
Cook, Earl, Ph. D., Professor and Dean of Geosciences
Doran, Edwin B., Ph. D., Professor and Head
Kimber, Clarissa T., Ph. D., Associate Professor
Saunderson, H. C., Ph. D., Assistant Professor

GEOLOGY

Ahr, Wayne M., Ph. D., Assistant Professor
Mathewson, Christopher C., Ph. D., Assistant Professor
Scott, Robert B., Ph. D., Associate Professor
Tieh, Thomas T., Ph. D., Associate Professor

MANAGEMENT

Seymour, John L., LL. M., Visiting Lecturer

MARINE ENGINEERING (Galveston)

Crosby, Gary, M. S., Associate Professor and Head
Marcontell, James, M. S., Assistant Professor
Moore, John, B. S., Lecturer
Tormollan, Francis, M. S., Associate Professor

MARINE SCIENCES (Galveston)

Aldrich, David V., Ph. D., Associate Professor
Beckman, Edward, M. D., Professor
Clayton, William H., Ph. D., Professor and Dean of Moody College of Marine Sciences and Maritime Resources
Kistler, Ernest, Ph. D., Associate Professor
McCloy, James, Ph. D., Assistant Professor
Park, Tai Soo, Ph. D., Assistant Professor
Ray, Sammy M., Ph. D., Professor and Head
Wilson, William B., Ph. D., Associate Professor

MARINE TRANSPORTATION AND NAUTICAL SCIENCE (Galveston)

Armstrong, Robert, B. S., Assistant Professor
Fanning, Karl, B. S., Assistant Professor
Lane, John, B. S., Assistant Professor
McMullen, William, B. S., Assistant Professor and Head
Philbrick, Alfred, M. Ed., Associate Professor and Assistant Superintendent, Master of the T/S Texas Clipper

MARKETING

Gillespie, Samuel M., Ph. D., Assistant Professor

METEOROLOGY

Das, Phanindramohan, Ph. D., Associate Professor
Franceschini, Guy A., Ph. D., Professor
Huebner, George L., Jr., Ph. D., Associate Professor
Thompson, Aylmer H., Ph. D., Professor

NAVAL SCIENCE

Hogan, Clarence E., Colonel, M. S., Professor and Head
McElroy, James R., Major, B. A., Associate Professor
Moore, Thomas S., Lieutenant, B. S., Assistant Professor
Page, Dorsie D., Lieutenant Colonel, B. S., Associate Professor
Shaff, Terry E., Lieutenant, B. A., Assistant Professor

NAVAL SCIENCE (Galveston)

Allen, R. Dean, Lieutenant, B. A., Associate Professor and Head
Darling, Larry W., Lieutenant, B. A., Assistant Professor
Gable, Phillip H., Chief Machinist Mate, Instructor
Mullins, Donald W., Chief Gunners Mate, Instructor

OCEANOGRAPHY

Berner, Leo, Jr., Ph. D., Associate Professor and Associate Dean of Graduate College
Bouma, Arnold H., Ph. D., Professor
Bright, Thomas J., Ph. D., Assistant Professor
Bryant, William R., Ph. D., Associate Professor
Cochrane, John D., M. S., Associate Professor
Darnell, Rezneat M., Ph. D., Professor
El-Sayed, Sayed Z., Ph. D., Associate Professor
Fahlquist, Davis A., Ph. D., Associate Professor
Geyer, Richard A., Ph. D., Professor and Head
Ichiye, Takashi, D. Sci., Professor

Jeffrey, Lela M., Ph. D., Assistant Professor
Nowlin, Worth D., Jr., Ph. D., Associate Professor
Pequegnat, Willis E., Ph. D., Professor
Poag, C. Wylie, Ph. D., Assistant Professor
Presley, Billy J., Ph. D., Assistant Professor
Reid, Robert O., M. S., Professor
Rezak, Richard, Ph. D., Professor
Schink, David R., Ph. D., Associate Professor and Assistant Dean for Research (Geosciences)
Sackett, William M., Ph. D., Professor
Treadwell, T. K., Jr., M. S., Instructor
Vastano, Andrew C., Ph. D., Associate Professor
Wormuth, John H., Ph. D., Assistant Professor

RECREATION AND PARKS

Gunn, Clare A., Ph. D., Professor
Hanna, John W., B. S., Instructor
Sessoms, Douglas H., Ph. D., Professor
Van Doren, Carlton S., Ph. D., Associate Professor

STATISTICS

Freund, Rudolf J., Ph. D., Professor

VETERINARY MICROBIOLOGY

Sparks, Albert K., Ph. D., Professor
Lewis, Donald H., Ph. D., Assistant Professor

WILDLIFE AND FISHERIES SCIENCES

Chittenden, Mark, Ph. D., Assistant Professor
Clark, William J., Ph. D., Associate Professor
Noble, Richard, Ph. D., Assistant Professor
Reimer, Rollin, Ph. D., Assistant Professor
Strawn, R., Kirk, Ph. D., Professor
Teer, James G., Ph. D., Professor and Head

To obtain further information, address all inquiries directly to:

Registrar
Texas A & M University
College Station, Texas 77843

TEXAS CHRISTIAN UNIVERSITY
Fort Worth, Texas 76129

In 1970 the university completed construction of a new physical sciences building including modern laboratory facilities for geology, chemistry and physics. The renovated science building houses the Departments of Biology, Psychology and Mathematics.

Several large laboratories have been designated for marine-oriented research and include four large seawater systems. Facilities are well equipped for systematic ecological, chemical and physiological marine studies. Studies of rivers, estuarines and shallow-water marine habitats are emphasized.

M.S. degrees are offered in biology, environmental science and geology with emphasis on marine problems.

M.S. in Environmental Science. This program is an interdisciplinary one between the Departments of Biology and Geology. All students must complete four graduate core courses. Nine hours of electives may be chosen from biology, geology or approved by the environmental sciences committee. Three hours of seminar and six hours of thesis must also be completed. Regardless of prior major discipline, the student should have a minimum of one year each of biology and chemistry and one course in physical geology. Students who do not have credit must complete at least one course in calculus and one in metropolitan and regional planning prior to completion of the degree.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF BIOLOGY

3104	Invertebrate Zoology	4
3203	Ecology	3
5713	Marine Ecology	3
5723	Aquatic Biology	3
6103	Invertebrate Morphology and Physiology	3
6302	Principles of Taxonomy	2
6313	Advanced Invertebrate Zoology	3
6503	Fishery Biology	3
6513	Field Techniques in Environmental Biology	3
7900	Thesis Research	6

DEPARTMENT OF GEOLOGY

3123	Descriptive Oceanography	3
3313	Invertebrate Paleontology	3
3323	Invertebrate Paleontology	3
5243	Geochemistry of Natural Waters	3
5313	Micropaleontology	3
5393	Environmental Geology	3
5513	Sedimentation	3
6213	Instrumental Analysis	3
6323	Principles of Paleoecology	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BIOLOGY

Britton, Joseph C., Jr., Ph. D., Assistant Professor
Couch, Ernest F., Ph. D., Assistant Professor
Forsyth, John, Ph. D., Professor
Hewatt, Willis G., Ph. D., Professor
Keith, Donald E., Ph. D., Assistant Professor
Lyles, Sanders T., Ph. D., Professor
McCracken, Michael D., Assistant Professor
Murphy, Clifford E., Ph. D., Professor
Newland, Leo G., Ph. D., Assistant Professor
Smith, J. Durward, Ph. D., Chairman and Associate Professor

DEPARTMENT OF GEOLOGY

Ehlmann, Arthur J., Ph. D., Professor
Rowett, Charles L., Ph. D., Assistant Professor
Steinmetz, Richard, Ph. D., Assistant Professor
Walper, Jack L., Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Donald E. Keith
Department of Biology
Texas Christian University
Fort Worth, Texas 76129

TUFTS UNIVERSITY
Medford, Massachusetts 02155

Research facilities are, for the most part, housed in three departments on the Medford campus and include

equipment for trace analysis such as spectrographs, mass spectrometers, ESR and NMR spectrometers, spectrophotometers, X-ray fluorescense spectrometers (and diffraction equipment), computers, atomic absorptionmeters, and ion-selective electrode meters. Marine facilities include the privately owned R/V SeaFoam, a 28-foot steel hull diesel auxiliary sloop. The vessel is equipped for coastal sampling, foam separation, photometry, pH, salinity and dissolves oxygen measurement. In addition, the Biology Department, through a consortium of local institutions, has use of the vessels and shore facilities of the Lerner Laboratory on Bimini Island in the Bahamas. It also makes use of facilities on Great Exume Island and in the Virgin Islands.

M.S. and Ph.D. degrees are offered in biology, chemistry and civil engineering with opportunities for specialization in marine biology, marine chemistry, sanitary engineering, law of the sea, etc.

B.S. degrees in marine sciences are available under a "plans-of-study" arrangement, whereby students formulate their own curricula with faculty approval and supervision.

General degree requirements are as follows: Ph.D., at least three academic years of study and research and preparation of a Ph.D. dissertation. M.S., advanced study of at least eight courses and (ordinarily) preparation of a dissertation. B.S. in Engineering, satisfactory completion of 36 courses including nine courses in one engineering department. B.S. in Engineering Science, several department concentration courses in the sciences may be substituted for a portion of the above. B.S. in Liberal Arts (chemistry, biology, etc.), satisfactory completion of 32 courses including at least ten approved courses in the major field. A senior thesis (Course 91, 92) is recommended in most cases.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Chem SS73	Chemical Oceanography	3
Chem 71, 72	Elementary Environmental Science	6
Chem 91, 92	Research (including Chemical Oceanography	6
C.E. 12	Water Resources Engineering	3
Geo 32	Geomorphology	--
Geo 141, 142	Sedimentation and Stratigraphy	--
Geo 148	Oceanography	3
M.E. 65	Intermediate Fluid Mechanics	--
E.S. 8	Fluid Mechanics	3

GRADUATE

Chem 295, 296, 297, 298	Research	--
C.E. 131	Advanced Hydraulics	3
C.E. 134	Water and Waste - Water Chemistry	3
C.E. 236	River and Lake Pollution	3

Credit hours are not stated in some cases. A "course" is ordinarily three credits unless accompanied by a laboratory, in which case it is ordinarily four credits. Courses numbered 100 or more are open to both graduate and undergraduate students.

The instructional staff for the courses listed above consists of the following:

CHEMISTRY

Dewald, Robert R., Ph.D., Associate Professor
Gibb, Thomas R.P., Jr., Ph.D., Professor
Illinger, Karl H., Ph.D., Professor

CIVIL ENGINEERING

Brown, Linfield C., Ph.D., Assistant Professor
Dunkerly, Paul A., S.M., Associate Professor
Hanes, N. Bruce, Ph.D., Professor

GEOLOGY

Hume, James D., Ph.D., Associate Professor
Stearns, Charles E., Ph.D., Professor

MECHANICAL ENGINEERING

Cole, John E., III, Ph.D., Assistant Professor
Trefethen, Lloyd McG., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Prof. Thomas R. P. Gibb, Jr.
Tufts University
Department of Chemistry
Medford, Massachusetts 02155
(617) 628-5000, ext. 256

Marine Science Program in Biology

The Biology Department is located on the main campus. It has well-equipped laboratories for teaching and research in physiology, biochemistry, animal behavior and ecology. Three temperature-controlled closed seawater systems of 50 to 75 gallons capacity are in operation. Eight of the 14 faculty members in the department are working or have worked with marine organisms.

The Biology Department does not own any marine field facility, but for the past eight years has conducted short concentrated field courses using our own staff at established field stations in the Caribbean or Bahamas. In the current year, these were carried on at the fully equipped Lerner Marine Laboratory in Bimini, Bahamas, in a consortium with the American Museum, Boston University and and Brandeis University; at Hummingbird Cay Biological Station, well equipped with field facilities and Boston Whaler boats and located near Great Exuma, Bahamas, and on a chartered 41-foot auxiliary sloop operating in the Virgin Islands and equipped for shallow-water field studies.

The following degrees are offered as part of the marine science program:

1. B.S. Thirty-two courses of which eight must be in biology and two in related fields. The undergraduate who includes the courses listed below will have a solid basis for a beginning job in marine science, but would be well advised to undertake graduate study in some specialized field of marine science. Two of last year's B.S. recipients are now in graduate school in marine science programs.

2. M.S. Eight courses plus an examination and a thesis. Assuming that the student started with a solid background in general biology, eight of the courses listed below plus a thesis on some topic in marine biology would fulfill the requirements. A specialty is not specified on the diploma. No M.S. degrees were awarded in this area last year.

3. Ph.D. Three years of academic work including an examination and dissertation. The only marine science program offered at this level at this time is in the physiology of marine organisms. None were awarded in this area last year.

The following courses are offered in conjunction with the above programs:

BIOLOGY

Bio 130	Animal Behavior (with laboratory)	5
Bio 142	Ecology (with laboratory)	5
Bio 143	Biology of Populations	3
Bio 148	Introductory Oceanography	3
Bio 154	Lower Plants (with laboratory)	5
Bio 164	Invertebrate Zoology (with laboratory)	5
Bio 193, 194	Individual Research Problems	1-6

Winter Study

100	Tropical Marine Biology (Bimini)	1 unit

101	Tropical Biology (Hummingbird Cay)	1 unit
103	Marine Biology (Virgin Islands)	1 unit

CHEMISTRY

S.S. 73	Marine Chemistry	3
C.E. 236	River and Lake Pollution	3

UNDERGRADUATE ONLY

Geo 22	Structural Geology	3
Geo 105, 106	Geomorphology	3, 3
Geo 141, 142	Sedimentation and Stratigraphy	3, 3

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Dane, Benjamin, Ph.D., Associate Professor
Feinleib, Mary Ella, Ph.D., Associate Professor
Hodgson, Edward S., Ph.D., Professor and Chairman
Maly, Edward S., Ph.D., Assistant Professor
Milburn, Nancy S., Ph.D., Professor
Nickerson, Norton H., Ph.D., Associate Professor
Roys, Chester C., Ph.D., Lecturer
Twarog, Betty M., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Dr. Chester Roys
Biology Department
Tufts University
Medford, Massachusetts 02155
(617) 628-5000

The Fletcher School of Law and Diplomacy offers instruction in international marine policy as one component of its generalist graduate curriculum in international affairs. Development and implementation of the program, currently in a pilot stage, is supported by a grant from the Office of Education. The program is being developed and offered in cooperation with Woods Hole Oceanographic Institution, which makes available members of its faculty and its research facilities for the use of Fletcher students with particular interest in marine policy. A number of Fletcher students have had the opportunity to pursue advanced graduate study at Woods Hole in the marine policy field.

The Fletcher School offers no degree specifically in marine policy. The school offers the degrees Master of Arts, Master of Arts in Law and Diplomacy, and Doctor of Philosophy in International Affairs. Studies in marine policy may comprise a part of the requirements for each degree for those students with a particular interest in the field. During the first year of program operation, an estimated 35 students have taken courses relevant to marine policy and participated in related activities.

The requirements for the degree of Master of Arts are completion of eight semester courses, demonstration of written and oral proficiency in a foreign language and passage of a comprehensive examination.

The requirements for the degree of Master of Arts in Law and Diplomacy are the completion of 16 semester courses, satisfactory presentation of a substantial research paper, demonstration of written and oral competence in a foreign language and passage of a comprehensive examination.

The requirements for the Ph.D. degree are passage of 16 semester courses, demonstration of written and oral competence in a foreign language, passage of the general oral examination, and successful presentation and defense of a substantial doctoral thesis.

No undergraduate courses are offered.

The following courses are offered in conjunction with the above programs:

Law 205	Seminar on Law of the Sea	3
Law 206	Introduction to Uses of the Seas	3
Law 210	International Organization	3
Dpl. 207	Science, Technology and American Foreign Policy	3
Eco. 233	Seminar on the Growth of Less Developed Countries	3
Pol. 211	Seminar on Political and Security Aspects of Oceans and Ocean Resources	3

The instructional staff for the courses listed above consists of the following:

INTERNATIONAL LAW

Franssen, Herman T., Ph.D., Visiting Lecturer
Gross, Leo, S.J.D., Professor
Haviland, H. Field, Jr., Ph.D., Professor
Ross, David, Ph.D., Visiting Lecturer

DIPLOMACY

Pfaltzgraff, Robert L., Ph.D., Associate Professor

ECONOMICS

Humphrey, Don D., Ph.D., Professor

POLITICS

Kemp, Geoffrey, Ph.D., Associate Professor
Wylie, Joseph C., RADM (USN-Ret.), Research Associate

To obtain further information, address all inquiries directly to:

Assistant Dean Allan Cameron
The Fletcher School of Law and Diplomacy
Tufts University
Mugar Hall
Medford, Massachusetts 02155
(617) 628-5000

UNITED STATES COAST GUARD ACADEMY
New London, Connecticut

The U.S. Coast Guard Academy is the federal service academy for the education and training of Coast Guard officers. The courses at the Academy lead to a Bachelor of Science degree. The entire curriculum is designed around the sea and marine maritime affairs. Of particular interest are programs in ocean science, marine engineering and ocean engineering.

Ocean Science courses are offered under the Department of Physical and Ocean Sciences. Special facilities include refrigerated aquariums, estuarine models, a weather-satellite photo receiver and a completely equipped fleet of small craft for oceanographic studies of Long Island Sound and adjacent waters. An IBM 1620 and a GE 225 computer are used in most ocean science courses and research projects. Summer programs utilize the large vessels of the Coast Guard for high sea and polar expeditions.

The course offerings are designed to give the student a taste of deepsea oceanography and biology as well as an appreciation for the coastal environment and problems. Students who select oceanography as a study option complete a basic pre-science-engineering background pro-

gram which consists of five semesters of math, three semesters of physics, two semesters of chemistry and of navigation, one semester of mechanics, thermodynamics, fluid mechanics, electrical science and basic naval architecture.

In addition there is the program of required oceanography courses as follows:

5218	Introduction to Marine Biology/Geology	4
5321	Physical Oceanography	4
5323	Biological Oceanography	4
5326	Meteorology	4
5420	Waves and Tides	3.5
5423	Estuarine Circulation and Pollution	
	And one or both of	
5426	Chemical Oceanography	4
5427	Marine Fisheries	3

In lieu of estuarine circulation and pollution, two full semester courses will be offered by 1974. These are:

Coastal Processes
Pollution

Instructional staff for the courses listed above consists of:

Costello, Hugh J., M. A. L. S., Associate Professor of Chemistry/Oceanography
Kollmeyer, Ronald C., CDR, USCG, M. S., Head, Ocean Science Section and Associate Professor of Oceanography
Lagerloef, Gary S. E., ENS, USCGR, B. S., Instructor of Oceanography/Meteorology
McGill, David A., Ph. D., Professor of Oceanography
Tolderlund, Douglas S., Ph. D., Assistant Professor of Oceanography

The ocean engineering and marine engineering curricula concentrate on courses in the Department of Applied Science and Engineering. The ocean engineering curriculum is designed to produce a strong foundation in engineering fundamentals especially as applied to the ocean environment. By proper choice of elective, a student may concentrate on instrumentation, on structures or experimentation. In addition to the basic background indicated above, the student completes the following ocean science courses:

5218	Introduction to Marine Biology/Geology	3.5
5321	Physical Oceanography	3.5
5410	Waves and Tides	3.5
	And one of:	
5326	Meteorology	3.5
5422	Chemical Oceanography	3.5
5420	Biological Oceanography	3.5

His engineering courses include an additional term of electrical engineering, and the following engineering courses:

1435	Materials Science	3.5
1312	Strength of Materials	3.5
	And two of:	
1494	Ocean Engineering Design and Analysis	4
1331	Mechanical Vibrations	3
1465	Automatic Control Systems	3
1455	Oceanographic Instrumentation	3.5
1431	Heat Transfer	3
3365	Design of Experiments	3

The marine engineering sequence is for the student who desires a sound foundation in marine engineering and naval architecture. The basic required courses are the same basics outlined for the ocean science sequence, except that two terms of electrical engineering are included, and two terms of ship design replace the basic naval architecture course. In addition the following courses are taken:

1435	Materials Science	3.5
1312	Strength of Materials	3.5
3315	Advanced Engineering Mathematics or Numerical Analysis (3351)	3
1493	Engineering Design and Analysis or Propulsion Design and Analysis (1499)	4
1491	Engineering Experimentation and Analysis	4

Additional electives in an engineering, mathematics or science area may be required.

Instructional staff for the courses in engineering include:

Boggs, Robert G., Ph. D.
Brooks, Larry D., LCDR, USCG, M. S. C. E.
Duncan, Robert S., Jr., LT, USCG, M. S. E.
Fletcher, Harold G., Jr., LCDR, USCG, M. S. E. E.
Freese, David H., Jr., LCDR, USCG, M. S. E. E.
Gathy, Bruce A., Ph. D.
Higginbotham, David E., S. M., P. E.
Lutkus, Anthony J., LT, USCG, M. S. E.
Mahler, Joseph, Ph. D.
Marucci, Thomas F. LCDR, USCG, Nav. E.
Maxham, John C., LT, USCG, Nav. E.
Polant, Ronald M., LCDR, USCG, M. S. E. E.
Sherrard, James R., LCDR, USCG, Nav. E.
Skinner, Bruce C., LCDR, USCG, Nav. E.
Thompson, Claude R., Captain, USCG, Nav. E., Department Head
Vance, George P., CDR, USCG, M. S. C. E.
White, Roderick M., CDR, USCG, Sc. D.
Wirtz, John C., CDR, USCG, M. S. E. E.

UNITED STATES MERCHANT MARINE ACADEMY
Kings Point, New York 11024

The academy's 39 buildings and marine facilities occupy 65 acres on the north shore of Long Island overlooking Long Island Sound and include academic buildings, resident halls, shops and laboratories. In addition, the academy operates miscellaneous small training craft on Long Island Sound.

The academy offers a four-year undergraduate program of study which leads to the degree of Bachelor of Science, a merchant marine license as third mate or third assistant engineer, and a commission as an ensign in the United States Naval Reserve. Three professional curriculums are offered: nautical science for the preparation of deck officers, marine engineering for the preparation of engineering officers, and a combination of both, called a dual license curriculum. Approximately one-third of each curriculum embraces general education courses.

As part of the four-year program, midshipmen are assigned to merchant vessels for practical experience in the operation of ships. They spend a total of 10 months at sea serving aboard American flag vessels on various trade routes. In addition to their shipboard duties, they are required to complete a written project.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF NAUTICAL SCIENCE

D380	Descriptive Oceanography I	3
D381	Descriptive Oceanography II	3
D382	Dynamic Oceanography I	3
D383	Dynamic Oceanography II	3
D361	Naval Architecture I	3
D462	Naval Architecture II	3
D463	Computer Applications to Naval Architecture Problems	3
D489	Environmental Pollution	3

DEPARTMENT OF MARITIME LAW AND ECONOMICS

L404	Maritime Law	3
L380	Management	3
L405	Advanced International Law of the Sea	3
L409	Advanced Admiralty Law	
L441	Marine Insurance	2
L485	Management Seminar	3

DEPARTMENT OF MATHEMATICS AND SCIENCE

M346	Oceanographic Chemistry I	4
M347	Oceanographic Chemistry II	4

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF NAUTICAL SCIENCE

Fiore, Cdr. A.E., USMS, M.S., Professor
Hurder, Capt. W.R., USMS, Professor and Head of the Department
May, Lieut. Cdr. R.B., USMS, Associate Professor
Nazzaro, Lieut. Cdr. P., USMS, M.A., Associate Professor
Pearson, Cdr. L., USMS, M.S., Professor
Roberts, W.M., Ph.D., Assistant Professor

DEPARTMENT OF ENGINEERING

Barnes, Lieut. Cdr. G.S., USMS, B.S., Associate Professor
Carlson, Cdr. S.O., USMS, M.M.E., Professor
Drucker, Cdr. J.H., USMS, M.E., M.S., Professor
Ferenczy, Lieut. Cdr. E.D., USMS, M.S., Associate Professor
Giaquinto, Lieut. j.g. L.A., USMS, Instructor
Gross, Cdr. M.J., USMS, M.M.E., Professor and Head of the Department
Hirschkowitz, Cdr. M.W., USMS, M.M.E., Professor
Hubert, Cdr. C.I., USMS, M.S.E.E., Professor
Kane, Lieut. L.B., USMS, B.M.E., Assistant Professor
Kingsley, Lieut. G.D., USMS, Assistant Professor
Kirby, Lieut. Cdr. H.M., USMS, M.A., Associate Professor
McDonald, Lieut. W.H., USMS, M.S., Assistant Professor
Madden, Lieut. R.T., USMS, M.S., Assistant Professor
Malinoski, Lieut. j.g. L.A., USMS, Laboratory Instructor
Maroney, Lieut.j.g. N.J., USMS, Laboratory Instructor
Panuska, Lieut. R.C., USMS, A.B., Assistant Professor
Paquette, Lieut. Cdr. D.R., USMS, M.S., Associate Professor
Reynolds, Lieut. F.X., USMS, M.S.M.E., Assistant Professor
Sandberg, Cdr. C.W., USMS, M.S., Professor
Schuler, Lieut. Cdr. F.X., USMS, B.S., Associate Professor
Sferazo, Lieut.j.g. L.J., USMS, Laboratory Instructor
Wells, Lieut. Cdr. R.B., USMS, B.S., Associate Professor

DEPARTMENT OF MATHEMATICS AND SCIENCE

Beim, Lieut. H.J., USMS, Ph.D., Assistant Professor
Dittrick, Capt. J.M., USMS, M.S., Professor and Head of the Department
Weiss, Lieut. E., USMS, M.S., Assistant Professor

To obtain further information, address all inquiries directly to:

Capt. Paul L. Krinsky (USMS)
Director of Admissions
United States Merchant Marine Academy
Kings Point, New York 11024

UNITED STATES NAVAL ACADEMY
Annapolis, Maryland 21402

The location of the Naval Academy, at the mouth of the Severn River on the Chesapeake Bay, is ideal for the conduct of field studies in oceanography, ocean systems engineering and meteorology. An 81-foot, 71-ton research vessel, supported by a pierside laboratory facility, is available for group or individual instruction and research. The vessel is fully instrumented for oceanographic and bathymetric data collection, including among its equipment an automatic precision positioning system, an automatic salinity/temperature/depth/sound velocity sensor-recorder, and a precision hydrographic echo sounder. Additionally the midshipmen are constructing a shallow-water habitat for use as a field laboratory.

Laboratory and computer utilization play a dominant role in the programs. Computer equipment available includes an IBM 1620 and a GE 650. A wide variety of modern laboratory equipment is provided, including a subcritical nuclear reactor, an oceanographic wave tank, an 85-foot towing tank with wave generating and on-line data acquisition and analysis capability, automatic chemical analysis equipment, marine aquaria, a semi-automatic weather station, a complete geology laboratory, and a wide variety of oceanographic and meteorological instruments. Construction has begun on a new engineering studies complex. Among the expanded laboratory facilities to be provided in the new engineering complex will be 380-foot and 120-foot towing tanks (both with random wave generators, on-line data acquisition and analysis capabilities), a coastal engineering basin, a large hyperbaric deep-ocean simulation facility, and a greatly expanded aquarium system for biological oceanographic studies.

The Naval Academy's purpose is to educate midshipmen in preparation for commissioning as career naval officers. Accordingly, midshipmen receive more than 30 semester hours of professional education in the fields of seamanship, tactics, navigation, weaponry, history, law and leadership. Additionally, midshipmen receive a broad liberal arts education in social science and humanities. These studies supplement the normal course of study in an engineering or environmental major and provide a sound foundation for professional development as a naval officer.

The degrees offered are a B.S. in Marine Engineering (13), a B.S. in Naval Architecture (seven), a B.S. in Ocean Engineering (20) and a B.S. with a designated major in Oceanography (132). (Figures in parenthesis are the numbers of degrees awarded in 1971-72.)

The marine engineering program places major emphasis on the principles of energy conversion and marine propulsion systems design and analysis for both nuclear and fossil fuel plants. Each student is required to complete at least 30 semester hours of courses in the field of marine engineering.

The naval architecture program encompasses a comprehensive analysis and design of vehicles that operate on, under or just above the air-sea interface. The curriculum covers the static and dynamic analyses of ships, both theoretically and experimentally, as well as basic design techniques. There are required 30 hours of courses in the field of naval architecture.

The ocean engineering program provides the student

with a fundamental introduction to the application of engineering in the undersea environment, with particular emphasis on structures, materials, wave mechanics, power, acoustics and life-support systems. At least 31 semester hours are required in the field of ocean engineering.

The oceanography program is primarily oriented toward achievement in the areas of physical oceanography and meteorology. Majors in oceanography must complete courses in mathematics through differential equations, chemistry, physics, biology, geology, naval engineering, thermodynamics and fluid dynamics. The basic course sequence within the major includes general meteorology, general oceanography, environmental dynamics and naval oceanographic applications. Additionally, a midshipman must complete three elective courses from within those offered in the department or from course offerings acceptable to the department chairman, given in the mathematics, physics, chemistry or engineering departments. A total of 37 semester hours are required in the major subjects.

The following courses are offered in conjunction with the above programs:

DEPARTMENT OF NAVAL SYSTEMS ENGINEERING

EN-200	Naval Engineering I	4
EN-361	Principles of Ocean Systems Engineering	4
EN-301	Naval Engineering II	4
EN-351	Naval Architecture I	3
EN-352	Naval Architecture II	3
EN-362	Reactor Physics I	3
EN-372	Engineering Properties of Marine Sediments	3
EN-373	Life Support Systems	3
EN-377	Ocean Systems Engineering Seminar	1
EN-375	Ocean Engineering Materials and Structures	4
EN-376	Coastal Engineering	3
EN-453	Naval Architecture III	3
EN-455	Ship Structure	3
EN-457	Hydrofoil and Propeller Theory	3
EN-458	Advanced Marine Vehicles	3
EN-460	Ocean System Design	3
EN-463	Reactor Physics II	3
EN-464	Reactor Control Analysis	3
EN-465	Advanced Reactor Theory	3
EN-466	Analysis of Marine Propulsion Equipment	3
EN-467	Design of Marine Power Plants	3
EN-472	Design of Submersibles and Support Vessels	3
EN-473	Ocean Engineering Mechanics	3
EN-477	Undersea Power Systems	3
EN-481	Advanced Topic in Naval Engineering	3
EN-491, 492	Naval Engineering Research, Design or Construction Project	1
EN-493, 494	Naval Engineering Research, Design or Construction Project	2
EN-495, 496	Naval Engineering Research, Design or Construction Project	3

DEPARTMENT OF PHYSICS

SP-301	Modern Physics	3
SP-411	Underwater Acoustics and Sonar	3

DEPARTMENT OF ENVIRONMENTAL SCIENCES

SG-161	Physical Geology	4
SO-111	Air/Ocean Environment	3
SO-212	General Oceanography	4
SO-221	Introduction to Oceanography	3
SO-241	General Meteorology	3
SO-312	Environmental Dynamics	3
SO-411	Naval Oceanographic Applications	4
SO-412	Environmental Instruments	3
SO-415	Environmental Pollution	3
SO-421	Ocean Waves and Tides	3
SO-422	Nearshore Oceanography	3
SO-423	Physical Oceanography	3
SO-441	Synoptic Meteorology	3
SO-442	Tropical Meteorology	3
SO-443	Physical Oceanography	3
SO-444	Climatology	3
SO-451	Biological Oceanography	3
SO-461	Geological Oceanography	3
SO-471	Chemical Oceanography	3
SO-491, 492	Oceanography Research Project	1
SO-493, 494	Oceanography Research Project	2
SO-495, 496	Oceanography Research Project	3

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF NAVAL SYSTEMS ENGINEERING

Anderson, Anders T., M.S. and Naval Eng., Chairman and Commander, USN
Barr, William A., M.S., Associate Professor
Bhattacharyya, Rameswar, Ph.D., Director of Naval Architecture and Associate Professor
Billow, Leon M., M.E., Assistant Professor
Bissell, Allen M., M.E., Lieut. Commander, USN
Blair, Thomas J., B.S., Lieut., USN
Bock, Arthur E., M.S., Professor
Compton, Roger H., Ph.D., Assistant Professor
Dulin, James E., B.S., Lieut., USN
Eckley, Wayne F., M.S., Associate Professor Emeritus
Flarey, Anthony J., B.S., Lieut., USN
Giannotti, Julio G., Ph.D., Assistant Professor
Henry, Gary R., Lieut., USN
Huckenpoehler, William B., Jr., M.N.E., Assistant Professor
Johnson, Bruce, Ph.D., Professor
Latham, Robert F., M.A., Director of Professional Courses and Associate Professor
Lewis, Martin E., M.S., Lieut. Commander, USN
Livingston, Donald J., B.S., Lieut. Commander, USN
Lomax, Tarrant H., B.S., Lieut., USN
Losure, John E., M.S., Associate Professor
McCormick, Michael E., Ph.D., Associate Professor
Monney, Neil T., Ph.D., Director of Ocean Engineering and Assistant Professor
Morrissey, Jon E., M.S., Lieut. Commander, USN
Nelson, Martin E., Ph.D., Assistant Professor
Oertel, "E" J., M.S., Lieut. Commander, USN
Prehn, Robert L., B.S., Lieut. Commander, USN
Rankin, Bruce H., Ph.D., Director of Marine Engineering and Professor
Remoll, Charles M., B.S., Lieut. Commander, USN
Schulden, William H., M.N.E., Assistant Professor
Short, Marshall S., B.S., Ensign, USN
Smart, Robert D., CivEngr., Lieut. Commander, USN
Sommers, Thomas A., B.S., Lieut., USN
Starks, Victor J., B.S., Lieut., USN
Twardy, Clement R., B.A., Lieut. Commander, USN
Uber, Thomas E., M.E.C.E., Lieut. Commander USN
Van Mater, Paul R., Jr., Ph.D., Associate Professor
Wiggins, Peter F., Ph.D., Deputy Chairman and Associate Professor

DEPARTMENT OF ENVIRONMENTAL SCIENCES

Clark, James F., B.S., Instructor
Edsall, Douglas W., M.S., Assistant Professor
Fleming, Charles H., B.S., Lieut. Commander, USN
Garthner, John P., B.S., Lieut. Commander, USN
Harlett, John C., Ph.D., Lieut. Commander, USN
Hendrix, Charles N.G., M.S., Associate Professor and Captain, USN (Ret.)
Hoffman, John F., M.S., Associate Professor
Keith, William H., M.S., Chairman and Commander, USN
Mommsen, Durward B., M.S., Lieut. Commander, USN
Nield, Van K., M.S., Lieut., USN
Snyder, Wallace H., M.S., Lieut. Commander, USN

Williams, Jerome, M.A., Associate Chairman and Associate Professor
Willoughby, Hugh E., M.S., Lieut., USN

To obtain further information, address all inquiries directly to:

Dean of Admissions
United States Naval Academy
Annapolis, Maryland 21402

THE VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

The major facilities of the Virginia Institute of Marine Science (VIMS) are at Gloucester Point, on the York River across from Yorktown. A branch laboratory at Wachapreague on the ocean side of the eastern shore of Virginia is primarily concerned with the development of techniques for the aquaculture of hard clams and bay scallops. VIMS is also involved in the operation of a hydraulic model of the James River at Vicksburg, Mississippi.

The Gloucester Point facility consists of several permanent buildings on a 30-acre site. Matthew Fontaine Maury Hall houses the institute's administrative and financial offices, an exhibit hall, and a 15,000-volume marine science library. The newest and largest building, Richard Evelyn Byrd Hall, has laboratory and office space for various ecology-pollution programs, the environmental physiology programs, applied marine biology studies, the institute's computer center and classrooms. A demonstration aquaculture and shellfish depuration laboratory is under construction. Other buildings are used for offices, laboratories and shops. The field station at Wachapreague includes a dormitory for 30 students and four instructors complete with kitchen, bathroom, laboratory and classroom spaces. All laboratories are in use year-round. Excellent reference collections of fishes and invertebrates are available. A world-wide collection of fish parasites is of particular interest.

The VIMS research fleet includes the R/V Pathfinder, a 55-foot trawler built in 1957 specifically for VIMS research; the R/V Langley, an 80-foot converted ferryboat; the R/V Virginia, a 50-foot ketch; the R/V Brooks, a 35-foot workboat; the R/V Investigator, a 28-foot cruiser; the R/V Observer, a 27-foot sea skiff, and a number of outboard powered skiffs. Larger vessels are chartered as required for offshore investigations.

Available equipment includes an electron microscope, automatic liquid scintillation counter, amino acid analyzer, fully equipped marine chemistry and pollution monitoring laboratories, current meters, salinometers and numerous other types of oceanographic instruments.

VIMS offers the degrees of Master of Arts and Doctor of Philosophy in Marine Science as the School of Marine Science, College of William and Mary, Williamsburg, Virginia; and the degrees of Master of Arts, Master of Science and Doctor of Philosophy in Marine Science as the Department of Marine Science, University of Virginia, Charlottesville, Virginia. The great majority of the courses included are taught at Gloucester Point by VIMS scientists so that students seldom need to visit the campuses at Williamsburg or Charlottesville. Some elective courses are offered at William and Mary.

General requirements for the degrees from William and Mary are listed; University of Virginia regulations differ slightly. Majors in biological oceanography (marine biology), general oceanography (physical, chemical or geological), and fisheries oceanography (marine fisheries biology) are available at both the M.A. and Ph.D. levels.

1. M.A. in Marine Science. Requirements: At least 30 semester credits of advanced work, including six for M.S. 560 (thesis), a minimum residence period of one calendar year, presentation of a thesis, at least six semester hours of one pertinent foreign language or satisfactory performance on an approved foreign language examination (german, french or russian is usually recommended), and satisfactory performance on a comprehensive examination.

2. Ph.D. in Marine Science. Requirements: A minimum of three years of graduate study beyond the baccalaureate (at least one academic year beyond the first must be spent in continuous residence as a full-time student), course requirements at the discretion of the school, completion and defense of a dissertation, reading knowledge of two approved foreign languages, and a comprehensive examination.

During the 1971-1972 academic year, VIMS granted 11 master's and eight doctoral degrees.

The following courses are offered in conjunction with the above programs. These courses are also offered under different numbers by the Department of Marine Science, University of Virginia.

401	Introduction to Physical Oceanography	3
402	Introduction to Chemical Oceanography	3
403	Introduction to Biological Oceanography	3
404	Introduction to Geological Oceanography	3
405	Problems in Marine Science	1-4
406	Introduction to Marine Science	5
407	Biometry I	3
410	Marine and Freshwater Invertebrates	5
412	Marine Botany	5
419	Computer Applications in Marine Science	1
420	Workshop in Scientific Writing	1
501	Marine Science Seminar	1-3
502	Advanced Biological Oceanography	3
503	Advanced Problems in Marine Science	1-4
504	Biology of Selected Marine Invertebrates	3
505	Radiobiology	4
507	Marine Microbiology	5
508	Ichthyology	5
510	Pollution Biology	4
511	Geological Oceanography	3
512	Parasites of Marine Organisms	5
513	Marine Biogeography	3
514	Littoral Processes	4
515	Embryology of Marine Invertebrates	5
518	Marine Fishery Science	4
519	Biometry II	3
510	Environmental Physiology	3
521	Chemical Oceanography	3
522	Environmental Physiology Laboratory	2
523	Topics in Applied Marine Science	1-4
524	Physiology of Marine Organisms	5
525	Hydromechanics	3
526	Geophysical Fluid Dynamics	3
527	Advanced Physical Oceanography	3
528	Micrometeorology and Hydrology of the Coastal Zone	3
529	Mechanics of Sedimentation in Coastal Environments I	4
530	Mechanics of Sedimentation in Coastal Environments II	4
531	Estuary and Shallow Water Hydrodynamics I	3
532	Estuary and Shallow Water Hydrodynamics II	3
533	Oceanographic Remote Sensing	3
540	Population Dynamics	4
541	Advanced Techniques in Statistical Analysis	1-3
544	Marine Mycology	4
545	Marine Phytoplankton	3
546	Marine Zooplankton	3
547	Marine Benthos	3
548	Marine Protozoology	4
549	Marine Resources in Public Affairs	2
560	Thesis	--
660	Dissertation	--

The instructional staff for the courses listed above consists of the following:

PROFESSORS

Andrews, Jay D., Ph.D.
Black, Robert E.L., Ph.D.
Hargis, William J., Jr., Ph.D., Dean of the School
Van Engel, Willard A., Ph.D.
Wood, John L., Ph.D.

ASSOCIATE PROFESSORS

Bender, Michael E., Ph.D.
Bieri, Rudolph H., Ph.D.
Byrne, Robert L., Ph.D.
Davis, William J., Ph.D.
Haefner, Paul A., Jr., Ph.D.
Haven, Dexter S., M.S.
Nichols, Maynard M., Ph.D.
Norcross, John J., M.S.
Wass, Marvin L., Ph.D.
Zubkoff, Paul L., Ph.D.

ASSISTANT PROFESSORS

Calder, Dale R., Ph.D.
Dupuy, John L., Ph.D.
Fang, Ching S., Ph.D.
Goldsmith, Victor, Ph.D.
Grant, George C., Ph.D
Hyer, Paul V., Ph.D.
Kazama, Frederick Y., Ph.D.
Kuo, Albert Y., Ph.D.
Loesch, Joseph, Ph.D.
Lynch, Maurice P., Ph.D.
MacIntyre, William G., Ph.D.
Marcellus, Kenneth L., Ph.D.
Musick, John A., Ph.D.
Ott, Franklyn D., Ph.D
Perkins, Frank O., Ph.D.
Ruzecki, Evon P., M.S.
Smith, Craig L., Ph.D.
Webb, Kenneth L., Ph.D.
Welsh, Christopher S., Ph.D.

INSTRUCTORS

Bolus, Robert L., M.S.
Merriner, John V., M.S.
Moncure, Richard W., B.S.
Warinner, Junius E. III., M.A.
Wojcik, Frank J., M.S.
Zwerner, David E., M.A.

ASSOCIATE FACULTY

Bick, Kenneth F.
Byrd, Mitchell A.
Ellison, Robert L.
Hewatt, Willis G.
Hopkins, Sewell H.
Humm, Harold J.
Liguori, Victor A.
Mangum, Charlotte P.
Morrill, John B.
Nelson, Bruce W.
Tyree, Sheppard Y., Jr.

To obtain further information, address all inquiries directly to:

Dr. William J. Hargis, Jr.
Director
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY
Blacksburg, Virginia 24061

Virginia Tech has on-campus research facilities for ocean engineering studies that include a towing tank for ship and submarine hydrodynamic studies, a water channel for pollutant dispersion studies, and a large, low-speed wind tunnel for air flow simulation of hydrodynamic phenomena. A wide range of structural testing equipment is also available.

The following degrees are offered (pending approval of the degree designation by the State Council on Higher Education):

1. B.S. in Aerospace and Ocean Engineering. Requirements: a minimum of 204 total quarter credit hours, 30 hours of humanaties and 18 hours of approved technical electives.

2. M.S. in Aerospace and Ocean Engineering. Requirements: 45 quarter credit hours include nine to 15 for thesis, or non-thesis option with 45 hours of course work, and oral final examination.

3. Ph.D. in Aerospace and Ocean Engineering. Requirements: 135 quarter credit hours including 45-85 for thesis, written and oral comprehensive examination to gain candidacy, and oral final examination.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

AE 2120	Vehicle Performance	3
AE-302	Ocean Engineering Models and Methods	3
AE 313	Structures I	3
AE 326	Ocean Engineering Laboratory	2
AE 323	Structures II	3
AE 304	Vehicle Vibration Analysis	3
AE 433	Structures III	3
AE 4040	Vehicle Stability and Control	3
AE 4025	Boundary Layer and Heat Transfer	3
GEOL 4014	General Oceanography	3
AE 4130	Design	3
AE 4230	Design	3
AE 497	Independent Study (arranged)	

GRADUATE

AE 501	Advanced Aerodynamics	3
AE 519, 529	Boundary Layer Theory and Heat Transfer	3,3
AE 597	Independent Study (arranged)	
AE 601	Three-dimensional Aerodynamics	3
AE 608	Dynamics of the Ocean	3
AE 609	Hydromechanics of Aquatic Animal Motion	3
AE 615, 625	Theory of Stratified Flow	3,3
AE 618, 628	Optimization Techniques	3,3

The instructional staff for the courses listed above consists of the following:

Cliff, Eugene M., Ph.D., Assistant Professor
Inger, George R., Ph.D., Professor
Jakubowski, Antoni K., Ph.D., Assistant Professor
Lewis, Clark H., Ph.D., Professor
Lutze, Frederick H., Ph.D., Associate Professor
Marchman, James F., Ph.D., Associate Professor
Rodden, William P., Ph.D., Professor
Schetz, Joseph A., Ph.D., Professor and Department Head
Wu, Yau, Ph.D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. Joseph A. Schetz
Aerospace and Ocean Engineering Department
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 951-6611

WALLA WALLA COLLEGE
College Place, Washington 99324

The college offers marine science courses at its marine station on Puget Sound near Anacortes. Supporting course work is offered on the main campus at College Place. Facilities for the maintenance and use of marine organisms in research are available in the life sciences complex completed on the main campus in 1967. The Walla Walla College Marine Biological Station provides six teaching and research laboratories serviced by a circulating salt-water system. In addition, the marine station operates two research vessels, the 40-foot Noctiluca and the 43-foot E. S. Booth, and has a 16-foot Boston Whaler. A number of smaller boats are available for research work associated with the courses being offered. Scuba equipment is available.

The degree of M. S. in Biology with an emphasis in marine biology is offered in the Department of Biology.

All students must complete a minimum of 45 graduate-approved credits, pass written and oral departmental examinations, and demonstrate ability to carry out independent research fulfilling the thesis requirement.

The degree of M. S. in Biology was awarded to six candidates during the 1971-72 school year.

The following courses are offered in conjunction with the above program:

UNDERGRADUATE

428	Physiology of the Algae	4
429	Limnology	4
451	Invertebrate Zoology	5
462	Ichthyology	4
463	Marine Botany	4
464	Animal Behavior	4
467	Biological Oceanography	4
468	Comparative Physiology	4
470	BioPhysics	4
474	Marine Invertebrates	4

GRADUATE

510	Graduate Seminar	1
511	Biosystematics	4
514	Symbiosis	4
525	Readings in Physiology	4
526	Readings in Invertebrate Zoology	4
528	Readings in Ecology	4
529	Readings in Symbiosis	4
530	Readings in Biosystematics	4
545	Thesis	8

The instructional staff for the courses listed above consists of the following:

BIOLOGY

Clayton, Dale L., Ph.D., Assistant Professor
Dickson, Leal G., Ph.D., Assistant Professor
Forss, Carl A., Ph.D., Associate Professor
Grable, Albert E., Ph.D., Associate Professor
McCloskey, Lawrence R., Ph.D., Assistant Professor
Perry, Alfred W., Ph.D., Associate Professor
Rigby, Donald W., Ph.D., Professor and Chairman, Department of Biology

ENGINEERING

McNiel, Oran E., Degree of Engineer, Assistant Professor and Director, Marine Biological Station

PHYSICS

Barnett, Claude C., Ph.D., Professor

To obtain further information, address all inquiries directly to:

Chairman, Department of Biology
Walla Walla College
College Place, Washington 99324

THE UNIVERSITY OF WASHINGTON
Seattle, Washington 98195

The University of Washington offers a variety of marine science-oriented programs using teaching and research facilities on its main campus and at several marine facilities in the Pacific Northwest and Alaska. Courses dealing with the ocean and of use to marine scientists are also offered in the Departments of Atmospheric Sciences, Economics, Geography, Geological Sciences, Geophysics, and in the College of Forest Resources. The university has established an Institute of Marine Studies to encourage interdisciplinary education and research programs, especially as they relate to policy and institutional problems of the oceans that combine natural sciences and engineering with law, economics, international affairs, and public administration. The Division of Marine Resources coordinates the Sea Grant Program, which involves courses related to marine resources taught in various departments and colleges.

The university also offers undergraduate and graduate programs in ocean engineering, fisheries, and law and marine affairs.

DEPARTMENT OF OCEANOGRAPHY

The Department of Oceanography has laboratory and ship facilities located along the Lake Washington Ship Canal on the main campus. The department occupies three permanent buildings (two of which were constructed in 1967 and 1968). Research vessels ranging in size from 65 feet to 208 feet (the R/V Hoh, R/V Onar and R/V Thomas G. Thompson) are operated by the department for inshore and deep-sea studies.

Special facilities include a closed salt-water system, controlled environment room; a tidal model of Puget Sound, wave tanks and rotating models, shipboard and shore-based IBM 1130 computers, a paleomagnetics laboratory, a sea-ice laboratory, X-ray emission and gamma-ray spectrometers, particle counters, provisions for work with radioactive isotopes, a chemostat laboratory, and a Scuba support facility. Also available are an excellent Fisheries-Oceanography Library, a well-equipped developmental laboratory, and the University Computer Center. Departmental teaching and research also use the university's Friday Harbor Laboratories, a marine biological station on San Juan Island, about 80 miles north of the main campus.

The department offers the Bachelor of Arts and the Bachelor of Science degrees. The student in either curriculum must meet the requirements of the College of Arts and Sciences, outlined in the university bulletin.

Students who have majored in oceanography or another science and appear likely to succeed in graduate study can be accepted in the program of the Department of Ocean-

ography. Admission is based on grade records, letters of recommendation, and the results of the Graduate Record Examination. Students who have not majored in oceanography should acquire a broad background in science and mathematics equivalent to the requirements for the baccalaureate degrees in oceanography. Additional information can be obtained from the Graduate Program Office.

The student specializes in biological, chemical, geological, geophysical or physical oceanography; interdisciplinary studies are possible. All requirements of the Graduate School must be satisfied.

The department offers a thesis and a non-thesis program leading to the Master of Science degree. In both, the student and his adviser prepare a program of study to be approved by the student's supervisory committee. A departmental comprehensive written examination is required. Language requirement is determined by the student's faculty adviser.

The department also offers a program leading to the Doctor of Philosophy degree. The student and his supervisory committee prepare a program of study and research and the student must pass a general examination in oceanography and supporting fields. He then completes the research for his dissertation and prepares for his final examination.

The following courses are offered in conjunction with the above programs.

UNDERGRADUATE

110	Lectures in Oceanography	1
111	Lectures in Oceanography	1
112	Lectures in Oceanography	1
203	Introduction to Oceanography	5
360	Methods and Instruments in Oceanography	3
385	The Oceans I	10
386	The Oceans II	10
388	Oceanography for Science Teachers	5
401	General Physical Oceanography I	5
402	General Physical Oceanography II	5
405	General Geological Oceanography	5
415	Fundamentals of Underwater Acoustics	3
416	Applications of Underwater Acoustics	2
417	Physical Oceanography I	5
418	Physical Oceanography II	5
419	Ocean Tides and Waves	5
421	Chemical Oceanography	2
422	Theoretical Chemical Oceanography	2
423	Chemical Oceanography Laboratory	2
424	Chemical Oceanography Laboratory	2
433	Biological Oceanography: Organisms and Processes	3
434	Biological Oceanography: Organisms and Environments	3
435	Biological Oceanography: Quantitative Aspects	3
443	Regional Oceanography	3
444	Design and Analysis of Oceanographic Experiments	3
450	Geological Oceanography	5
452	Physical Sedimentology	3
454	Biogenic Sediments I	3
455	Biogenic Sediments II	3
456	Acoustic and Seismic Techniques	2
457	Marine Sedimentation	3
458	Chemical Aspects of Marine Sediments	3
460	Field Experience in Oceanography	1-6
462	Applications of Oceanography	2
488H	Field Experience - Honors	2-6
499	Undergraduate Research	1-12

GRADUATE

505	Current Problems in Geological Oceanography	1
511	Marine Hydrodynamics I	4
512	Marine Hydrodynamics II	4
513	Marine Hydrodynamics III	4
514	Seminar in Physical Oceanography	1
515	Waves	4
516	Ocean Circulation	2
517	Oceanography of Inshore Waters	5
518	Seminar in Dynamical Oceanography	1
519	Interaction of the Sea and Atmosphere	5
520	Seminar	0
521	Seminar in Chemical Oceanography	*
523	Advanced Problems in Chemical Oceanography	1-4
530	Marine Primary Productivity	3
531	Seminar in Biological Oceanography	*
532	Marine Microbiology	1-4
533	Zooplankton Ecology	3 or 6
534	Phytoplankton Ecology	6
535	Advanced Plankton Ecology	3
536	Benthos Ecology	3
537	Environmental Physiology of Marine Microalgae	4
538	Identification and Structure of Marine Benthic Communities	2
540	Seminar in Geometronics	1-3
544	Statistical Models in Oceanography	3
548	Topics in Physical Oceanography	1-4
550	Seminar in Geological Oceanography	*
551	Marine Sediments	2
553	Research Techniques in Marine Geochemistry	2
555	Marine Geochemistry	3
556	Advanced Marine Geology	*
560	Fluid Mechanics of Erosion and Sediment Transport	3
561	Seminar in Geological Fluid Mechanics	3
570	Simulation Analysis of Marine Systems	5
571	Gravity and Geomagnetic Interpretation	3
573	Terrestrial Magnetism	3
581	Analysis of Sediments and Sedimentary Rocks	5
600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

*Credit to be arranged.

In addition to the course offerings leading to the degrees mentioned, courses dealing with the ocean and of use to marine scientists are offered in the Departments of Botany, Geophysics, Atmospheric Sciences, Zoology, the School of Business Administration, Geography, the College of Forest Resources, the Department of Economics and the School of Law. The Division of Marine Resources coordinates the Sea Grant Program, which involves courses related to marine resources, taught in various departments and colleges.

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF OCEANOGRAPHY

Aagaard, Knut, Ph.D., Research Assistant Professor
Anderson, George C., Ph.D., Research Professor
Banse, Karl, Ph.D., Professor
Barnes, Clifford A., Ph.D., Professor
Bennett, Lee C., Jr., Ph.D., Assistant Professor
Burns, Robert E., Ph.D., Affiliate Associate Professor
Campbell, William, Ph.D., Affiliate Associate Professor
Cannon, Glenn A., Ph.D., Affiliate Associate Professor
Carpenter, Roy, Ph.D., Assistant Professor
Coachman, Lawrence K., Ph.D., Professor
Codispoti, Louis A., Ph.D., Acting Assistant Professor
Creager, Joe S., Ph.D., Professor
Criminale, William O., Jr., Ph.D., Associate Professor
Dugdale, Richard C., Ph.D., Research Professor
Duxbury, Alyn C., Ph.D., Research Assistant Professor
Echols, Ronald J., Ph.D., Research Assistant Professor
English, T. Saunders, Ph.D., Associate Professor
Ewart, Terry E., Ph.D., Senior Research Associate
Fleming, Richard H., Ph.D., Professor
Frost, Bruce W., Ph.D., Assistant Professor
Halpern, David, Ph.D., Affiliate Associate Professor

Hasselman, D. E., Ph. D., Research Associate Professor
Healy, Michael L., Ph. D., Research Assistant Professor
Henry, Dora P., Ph. D., Research Associate Professor
Irish, J. D., Ph. D., Research Assistant Professor
Kelley, James C., Ph. D., Associate Professor
Kennar, R., Ph. D., Research Associate Professor
Larsen, Lawrence H., Ph. D., Research Associate Professor
Lee, F. E., Ph. D., Senior Research Associate
Lewin, Joyce C., Ph. D., Professor
Ling, Hsin-Yi, Ph. D., Research Associate Professor
Lister, Clive R. B., Ph. D., Associate Professor
McManus, Dean A., Ph. D., Professor
Martin, Seelye, Ph. D., Research Assistant Professor
Merrill, Ronald T., Ph. D., Associate Professor
Murphy, Stanley R., Ph. D., Professor of Oceanography and of Mechanical Engineering; Director, Division of Marine Resources
Packard, T. T., Ph. D., Senior Research Associate
Pavlou, S., Ph. D., Research Associate Professor
Piper, David Z., Ph. D., Assistant Professor
Prinsenberg, S., Ph. D., Research Associate Professor
Rattray, Maurice, Jr., Ph. D., Chairman and Professor
Richards, Francis A., Ph. D., Professor
Roden, Gunnar I., M. S., Senior Research Associate
Smith, J. Dungan, Ph. D., Associate Professor
Smith, T. D., Research Associate
Walsh, J. J., Ph. D., Research Assistant Professor
Winter, Donald F., Ph. D., Acting Associate Professor
Worsley, Thomas, Ph. D., Senior Research Associate

For further information, address all inquiries directly to:

Ms. Carolyn Hartness
Curriculum Adviser
108 Oceanography Teaching Building WB-10
Department of Oceanography
University of Washington
Seattle, Washington 98195

DEPARTMENT OF BOTANY

The Department of Botany's principal teaching and research facilities are located in Johnson Hall on the main campus and at the Friday Harbor Laboratories. These include marine and freshwater algal culture facilities, numerous cultures of marine algae, a collection of preserved algae in a special algal herbarium, and Scuba diving equipment. There is a boat for field work and a larger vessel is available at the Friday Harbor Laboratories for dredging operations.

In addition to the Bachelor of Science degree program in botany, the department offers both a Master of Science and a Ph. D. degree program, with special emphasis in marine algology and marine mycology.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

443	Freshwater Algae	5
445	Marine Botany	7
446	Algology	5
447	Phytoplankton Morphology and Taxonomy	5
448	Marine Algal Ecology	5

GRADUATE

524	Topics in Algology	2
545	Marine Algology	6
565	Marine Mycology	6

Instructional staff for the courses listed above includes the following:

Norris, Richard, Ph. D., Professor
Waaland, Robert, Ph. D., Assistant Professor
Whisler, Howard, Ph. D., Associate Professor

To obtain further information, address all inquiries directly to:

Dr. A. R. Kruckeberg, Chairman
Department of Botany
240 Johnson Hall AK-10
University of Washington
Seattle, Washington 98195

DEPARTMENT OF ZOOLOGY

The Department of Zoology's offices and laboratories are in Kincaid Hall (opened December 1971) on the main campus with facilities for advanced instruction and research including controlled environment seawater aquarium rooms. The modern facilities of the Friday Harbor Laboratories on San Juan Island are also available for instruction and research on marine organisms.

While the department does not offer a degree in marine biology, students pursuing degree programs may strongly emphasize this area by selecting a variety of marine biology courses in fulfilling the degree requirements. Two undergraduate degree programs are offered: Bachelor of Arts and Bachelor of Science. Candidates for either must meet the requirements of the College of Arts and Sciences.

Graduate programs in the Department of Zoology including course work and research lead to the Master of Science and Doctor of Philosophy degrees. A non-thesis master's program is also offered. The major fields of interest in the department are cellular and developmental biology, general and comparative physiology, ecology and ethology, and vertebrate and invertebrate zoology. A graduate student interested in marine biology may take several courses in the department or in one of a complex of departments of biological sciences at the university. Entering students should have completed the following courses: organic and/or physical chemistry, one year of college physics, mathematics through calculus, and a survey of the plant kingdom. Reading proficiency is required in at least one of the following languages: french, german, japanese or russian. All students are required to gain some teaching experience regardless of source of support. With the objective of insuring a broad background in zoology, an entering graduate student participates in a diagnostic conference with a faculty committee. The student's academic strengths and weaknesses are assessed in view of the student's interests and a course of studies is prescribed. A general oral examination taken in the third or fourth year includes the defense of an original research proposal and precedes candidacy for the Ph. D. degree.

The following marine-related courses are included in the Department of Zoology curriculum:

UNDERGRADUATE

330	Natural History of Marine Invertebrates	5
430	Marine Zoology	8
432	Marine Invertebrate Zoology	8
433	Invertebrate Zoology	5
434	Invertebrate Zoology	5

GRADUATE

533	Advanced Invertebrate Zoology	6
534	Topics in Advanced Invertebrate Zoology	3
536	Comparative Invertebrate Embryology	6
538	Advanced Invertebrate Physiology	6
572	Topics in Ecology	2-3
574	Ecology of Marine Communities	3
576	Environmental Marine Physiology	6

The instructional staff for the courses listed above includes the following:

Cloney, Richard A., Ph. D., Professor
Fernald, Robert L., Ph. D., Professor

Illg, Paul L., Ph. D., Professor
Johansen, Kjell, Ph. D., Associate Professor
Kohn, Alan J., Ph. D., Professor
Kozloff, Eugene N., Ph. D., Professor
Martin, Arthur W., Ph. D., Professor
Paine, Robert T., Ph. D., Professor
Whiteley, Arthur H., Ph. D., Professor
Willows, A. O. Dennis, Ph. D., Associate Professor and Director, Friday Harbor Laboratories

To obtain further information, address all inquiries directly to:

Dr. Alan Kohn
Department of Zoology
448 Kincaid Hall (NJ-15)
University of Washington
Seattle, Washington 98195

OCEAN ENGINEERING PROGRAM

The Ocean Engineering Program at the University of Washington has been designed to take advantage of the breadth of marine and engineering-oriented curricula on campus and of the natural setting of Seattle with respect to the marine environment. The undergraduate student may begin a specialty through the Interdisciplinary Engineering Studies Program; the graduate student will be enrolled in a graduate degree program offered by the faculty of the engineering department that best fits his background and objectives. The program for the particular student is arranged on an individual basis, built around the specialties within his engineering department, with related course work from oceanography, fisheries, atmospheric sciences, economics, etc. These are required for the Master of Science and Ph. D. degrees.

The laboratory facilities on campus and in the field which are used to support teaching and research in ocean engineering are coordinated by the director of the Ocean Engineering Research Laboratory. A subsonic wind tunnel (8-foot by 12-foot section, 180 mph) with an external air supply at a pressure of 3,000 pounds per square inch with a mass flow of 1.5 pounds per second is operated in aeronautics and astronautics. A large Chemical Engineering Laboratory with special facilities such as a 20-foot glass distillation column, a 20-foot absorption column, and a fluid (air and water) loop for research and calibration is available. Laboratories for hydraulics, wave studies, structures, materials, soil mechanics, water biology and chemistry are located in civil engineering. Those for acoustics, electronics and control systems, and energy conversion are in electrical engineering. Mechanical engineering has laboratories of heat transfer and thermodynamics, experimental stress analyses, material processing, and vibrations and acoustics. A ceramics laboratory and those for material properties and mineral processing are available through mining, metallurgy and ceramics. Nuclear engineering has a separate teaching and research nuclear reactor (100 KW argonaut type) housed in a separate facility. Part of the work done by the Applied Physics Laboratory is marine-oriented and, when there is a match between student interest and project, the thesis research may be performed through this laboratory. A bottom-mounted, surface-piercing instrument platform in Puget Sound is available. Outstanding collections of books and periodicals of interest to the engineer and marine scientist and a research computer laboratory round out the facilities.

The Division of Marine Resources acts as coordinator of the work being carried out in the marine-related sciences between the many departments and colleges of the university which are active in this field. These include atmospheric sciences, botany, chemical engineering, civil engineering, electrical engineering, oceanography, and zoology. It also coordinates the Sea Grant Program, which involves courses related to marine resources taught in various departments and colleges.

The following courses are offered in conjunction with the above programs:

AERONAUTICS AND ASTRONAUTICS

510	Wave Propagation in Fluids and Solids	3
567	Analysis in Engineering I	3
568	Analysis in Engineering II	3
600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

CHEMICAL ENGINEERING

600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

CIVIL ENGINEERING

Core Courses

CIVE 506	Probabalistic Design Theory	3
CIVE 543	Marine Technology Affairs I	3
CIVE 544	Marine Technology Affairs II	3
CIVE 599	Special Topics - Water and Air Resources	3
CIVE 600	Independent Study or Research	*
CIVE 700	Master's Thesis	*
CIVE 800	Doctoral Dissertation	*

Transportation, Construction and Geotechnical Courses

CETC 523	Transportation Terminals	3

Water and Air Resources

CEWA 444	Coastal Engineering I	3
CEWA 450	Man and the Pollution of his Environment	3 or 5
CEWA 452	System Engineering Fundamentals	3
CEWA 453	Water and Waste-Water Treatment	3
CEWA 457	Water Quality Analysis	3
CEWA 487	Industrial Waste Management	3
CEWA 541	Hydrodynamics in Water Quality	3
CEWA 542	Hydrodynamics I	3
CEWA 543	Hydrodynamics II	3
CEWA 544	Coastal Hydraulics	3
CEWA 556	Industrial Waste Treatment	3
CEWA 558	Water Quality Management	3
CEWA 559	Water Resources System Management	3

ELECTRICAL ENGINEERING

421	Electroacoustics	4
505	Analysis of Random Processes	4
518	Digital Signal Processing	4
519	Measurement and Analysis of Random Data	3
525	Acoustics in Engineering I	3
526	Acoustics in Engineering II	3
595	Advanced Topics in Communication Theory	3
600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

MECHANICAL ENGINEERING

406	Corrosion and Surface Treatment of Materials	3
470	Mechanical Vibrations	3
473	Instrumentation	
490	Naval Architecture	3
491	Naval Architecture	3
492	Naval Architecture	3
567	Advanced Dynamics	3
590	Random Mechanical Vibrations	3
600	Independent Study or Research	*

700	Master's Thesis	*
800	Doctoral Dissertation	*

CERAMIC, METALLURGICAL AND MINING ENGINEERING

CERE 600	Independent Study or Research	*
CERE 700	Master's Thesis	*
CERE 800	Doctoral Dissertation	*
METE 423	Corrosion of Engineering Materials	3
METE 600	Independent Study or Research	*
METE 700	Master's Thesis	*
METE 800	Doctoral Dissertation	*
MINE 426	Exploration and Development of Mineral Deposits	4
MINE 427	Exploration Geophysics: Introduction	3
MINE 481	Mineral Industry Economics	3
MINE 600	Independent Research	*
MINE 700	Master's Thesis	*

NUCLEAR ENGINEERING

486	Nuclear Power Plants	3
700	Master's Thesis	*
800	Doctoral Dissertation	*

OCEAN ENGINEERING

498	Special Topics in Ocean Engineering	1-5
551	Ocean Engineering Systems Design I	3
552	Ocean Engineering Systems Design II	3

*Credit To Be Arranged.

The instructional staff for the courses listed above includes the following:

DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

Bollard, R. J. H., Ph. D., Professor and Chairman
Fyfe, Ian F., Ph. D., Professor of Aeronautics
Vagners, Juris, Ph. D., Assistant Professor of Aeronautics and Astronautics

DEPARTMENT OF CHEMICAL ENGINEERING

Gardner, Howard S., Sc. D., Professor of Chemical Engineering and of Pulp and Paper Technology
Moulton, R. Wells, Ph. D., Professor and Chairman

DEPARTMENT OF CIVIL ENGINEERING

Carlson, Dale A., Ph. D., Professor and Chairman
Christman, Russell F., Ph. D., Associate Professor of Chemistry
Brown, Colin B., Ph. D., Professor of Civil Engineering
Hartz, Billy J., Ph. D., Professor of Civil Engineering
Mar, Brian W., Ph. D., Professor of Civil Engineering
Nece, Ronald E., Sc. D., Professor of Civil Engineering
Richey, Eugene P., Ph. D., Professor of Civil Engineering
Sherif, Mehmet A., Ph. D., Associate Professor of Civil Engineering
Sylvester, Robert O., S. M., Professor of Civil Engineering
Welch, Eugene B., Ph. D., Associate Professor of Applied Biology
Wenk, Edward, Ph. D., Professor of Engineering and Public Affairs

DEPARTMENT OF ELECTRICAL ENGINEERING

Clark, Robert N., Ph. D., Professor of Electrical Engineering
Dow, Daniel G., Ph. D., Professor and Chairman of Electrical Engineering
Lytle, Dean W., Ph. D., Professor of Electrical Engineering
Rogers, Walter E., M. S., Professor of Electrical Engineering
Sigelmann, Rubens A., Ph. D., Associate Professor of Electrical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING

Adee, Bruce, Ph. D., Assistant Professor of Mechanical Engineering
Galle, Kurt R., Ph. D., Associate Professor of Mechanical Engineering
Gray, Gordon M., Ph. D., Research Associate Professor and Director, Ocean Engineering Research Laboratories
Jorgensen, Jens E., Sc. D., Assistant Professor of Mechanical Engineering
Kippenhan, Charles J., Ph. D., Professor and Chairman, Mechanical Engineering
Merchant, Howard C., Ph. D., Associate Professor of Mechanical Engineering
Murphy, Stanley R., Ph. D., Professor of Oceanography and Mechanical and Ocean Engineering
Sandwith, Colin, Ph. D., Assistant Professor of Mechanical Engineering
Vesper, Karl H., Ph. D., Associate Professor of Management and Organization and of Mechanical Engineering

DEPARTMENT OF MINING, METALLURGICAL AND CERAMIC ENGINEERING

Brien, Frederick B., M. S., Professor of Mineral Engineering
Polonis, Douglas H., Ph. D., Professor and Chairman of Mining, Metallurgical and Ceramic Engineering
Zupp, Richard R., Ph. D., Assistant Professor of Metallurgical Engineering

DEPARTMENT OF NUCLEAR ENGINEERING

Babb, Albert L., Ph. D., Professor and Chairman of Nuclear Engineering and Director, Nuclear Reactor Laboratories
Woodruff, Gene L., Ph. D., Associate Professor of Nuclear Engineering and Associate Director, Nuclear Reactor Laboratories

To obtain further information, direct all inquiries to:

Professor Eugene P. Richey
313 Harris Hydraulics Laboratory (WD-10)
University of Washington
Seattle, Washington 98105

COLLEGE OF FISHERIES

The College of Fisheries field station at Big Beef Creek on Hood Canal provides additional opportunities for class field studies and research in stream and estuarine ecology. The food science facilities include separate well-equipped laboratories for food microbiology, food biochemistry and food analysis. A unique feature is the cobalt 60 research irradiator. A 67-foot diesel-powered boat, operated by the college, is capable of trawling to a depth of 1,000 fathoms and is equipped for other types of fishing as well as a wide variety of experimental work.

Basic requirements for admission to the graduate program in the college are a bachelor's degree from an institution of recognized standing with a grade point average of 3.00 in the junior and senior years of college work.

The following degrees are offered in the College of Fisheries:

1. Bachelor of Science and Bachelor of Science in Fisheries. Bachelor's degrees require completion of a common core curriculum in basic science (30 quarter credits), mathematics and statistics (9-11 quarter credits), environmental science (11 quarter credits), and social science (11 quarter credits). In addition to the core curri-

culum, the student selects one or two sets of prescribed courses from seven areas of emphasis. The sets consist of 25-30 quarter credits. The areas of emphasis are: fish culture, invertebrate culture, recreational fisheries, aquatic resource management, water quality, fish processing, and general environmental study.

2. Bachelor of Science (Food Science). To obtain this degree in the food science program, the student must complete the requirements for university graduation with at least 10 credits in humanities and biological studies. Courses in biochemistry, chemistry, mathematics, physics, preventive medicine and Fisheries 395 and Food Science 380, 481, 483, 484, 485, 486, 487 and 498 are required.

3. Master of Science. At least one year of approved study with a completion of a research project and thesis leads to the master's degree. A minimum of 45 upper-division or graduate credits must be presented including 18 credits in Fisheries 700 or Food Science 700, six credits in Fisheries 520 or Food Science 521 and three additional credits in courses numbered 500 or above.

4. Doctor of Philosophy. Students must complete at least three years of graduate study including a dissertation. Credits earned for a master's degree may be applied toward the doctor's degree. Students must demonstrate proficiency in the translation of one foreign language.

The following courses are offered in conjunction with the above programs:

FISHERIES

101	Introduction to Fisheries Science	5
311	Biology of Fishes	3
314	Methods and Instruments for Fishery Investigations	3
340	Applications of Digital Computers to Biological Problems	4
367	Recreational Fisheries	3
379	Fisheries of the World	3
395	Literature Search	3
401	Classification of Economically Important Fishes	5
405	Economically Important Mollusca	5
406	Economically Important Crustacea	5
425	Life History of Marine Fishes	5
435	Physiological Effects of Water Pollutants	3
444	Fisheries Genetics	3
451	Reproduction of Salmonoid Fishes	5
452	Nutrition and Care of Fishes	5
454	Communicable Diseases of Fishes	5
459	Aquatic Food Chains	5
460	Water Management and Pollution Studies	5
465	Problems in Fish Biology	6
471	Principles of Aquatic Radioecology	3
472	Methods of Aquatic Radioecology	3
473	Radionuclides in the Aquatic Environments	3
477	Applied Chemical Techniques in the Aquatic Environment	3
499	Undergraduate Research	1-3
501	On-the-job Training	1-3
503	Systematic Ichthyology	5
504	Invertebrate Pathology	5
505	Research Techniques in Shellfish Biology	5
506	Shellfish Sanitation	5
507	Topics in Fish Ecology	1-5
515	Fish Physiology	3
516	Fish Physiology Laboratory	2
520	Graduate Seminar	2
525	Ecology of Marine Fishes	3
531	Seminar in Water Pollution Problems	3
535	Metabolic Effects of Chemical Pollutants	4
540	Application of Digital Computers to Problems in Aquatic Ecology	3
545	Speciation	3
556	Introduction to Quantitative Population Dynamics	3
557	Theoretical Models of Exploited Animal Populations	3
558	Estimation of Population Parameters	3
600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

FOOD SCIENCE

378	Principles of Fishing Gear and Vessel Development	3
380	Principles of Fisheries Technology	3
381	Environment, Food and Technology	3
481	Introduction to Food Technology	5
482	Principles of Food Analysis I	5
483	Principles of Food Analysis II	5
484	Principles of Food Processing I	5
485	Principles of Food Processing II	5
486	Deteriorative Processes in Food	5
498	Undergraduate Thesis	2-6
504	Principles of Technological Research in Food	3
521	Graduate Seminar in Food Science	2
522	Biological and Chemical Origins of Foods and Food Components and Their Functional Characteristics	3
523	Advanced Marine Food Processes	5
524	Microorganisms in Foods	4
525	Advanced Unit Operations in Food Processing	3
526	Advanced Unit Operations in Food Processing Laboratory	3
600	Independent Study or Research	*
700	Master's Thesis	*
800	Doctoral Dissertation	*

*Credit To Be Arranged.

CENTER FOR QUANTITATIVE SCIENCE

270	Systems Analysis and Management, Science Methodology in Resource Management	3
281	Elements of Statistical Method	5
291	Analysis for Biologists	3
292	Analysis for Biologists	3
340	Applications of Digital Computers to Problems In Resource Management	4
376	Operations Research in Resource Utilization I	3
381	Elementary Concepts in Statistics	4
382	Statistical Inference in Applied Research	5
383	Statistical Inference in Applied Research	5
391	Introduction to Matrices and Their Applications	3
392	Techniques of Applied Mathematics in Biology I	3
393	Techniques of Applied Mathematics in Biology II	3
450	Ecological Models	4
456	Mathematical Models in Population Biology	4
457	Management of Exploited Animal Populations	4
461	Thermodynamics of Life Processes	4
462	Irreversible Thermodynamics in Biology	4
471	Systems Analysis in Resource Management	4
476	Operations Research in Resource Utilization II	3
477	Advanced Programming with Applications in Resource Management	3
480	Sampling Theory for Biologists	4
486	Experimental Design	3

The instructional staff for the courses listed above includes the following:

Bell, Milo, B.S., Professor
Bevan, Donald E., Ph.D., Professor
Bonham, Kelshaw, Ph.D., Research Professor
Brown, George W., Ph.D., Associate Professor
Burgner, Robert L., Ph.D., Professor and Director, Fisheries Research Institute
Chapman, Douglas G., Ph.D., Professor and Dean
Chew, Kenneth K., Ph.D., Professor
DeLacy, Allan C., Ph.D., Professor
Donaldson, Lauren R., Ph.D., Professor
Gallucci, Vincent F., Ph.D., Research Assistant Professor
Hansen, Randall G., M.S., Lecturer
Held, Edward, Ph.D., Research Professor (on leave)
Hershberger, William K., Ph.D., Assistant Professor
Jones, G. Ivor, Ph.D., Acting Associate Professor (on leave)

Kasahara, Hiroshi, Dr. of Agriculture, Professor (on leave)
Liston, John, Ph.D., Professor and Director, Institute for Food Science and Technology
Matches, Jack, Ph.D., Associate Professor
Mathews, Stephen, Ph.D., Acting Assistant Professor
Mathisen, Ole A., Ph.D., Professor (on leave)
McCaughran, Donald, Ph.D., Assistant Professor
Nakatani, Roy E., Ph.D., Acting Professor and Assistant Director, Fisheries Research Institute
Pigott, George M., Ph.D., Professor
Riddle, Victor M., Ph.D., Associate Professor
Rogers, Donald E., Ph.D., Research Assistant Professor
Royce, William F., Ph.D., Professor (on leave)
Salo, Ernest O., Ph.D., Professor
Seymour, Allyn H., Ph.D., Professor and Director, Laboratory of Radiation Ecology
Smith, Lynwood S., Ph.D., Professor
Stober, Quentin J., Ph.D., Research Assistant Professor
Taub, Frieda B., Ph.D., Professor
Tillman, Michael, Ph.D., Acting Assistant Professor
Van Cleve, Richard, Ph.D., Professor
Welander, Arthur D., Ph.D., Professor
Whitney, Richard R., Ph.D., Professor
Wissmar, Robert, Ph.D., Research Associate
Wydoski, Richard S., Ph.D., Associate Professor

For further information, address all inquiries directly to:

Dr. Douglas G. Chapman, Dean
College of Fisheries
University of Washington
Seattle, Washington 98105

LAW AND MARINE AFFAIRS

For students who have completed their first degree in law, the School of Law at the University of Washington offers a course of study in law and marine affairs leading to the LL.M. degree. Particular emphasis is placed upon the interdisciplinary aspects of marine affairs. Curricular offerings are available in the School of Law, the College of Fisheries, the Department of Oceanography, the Graduate School of Public Affairs, the College of Engineering, the Department of Economics, and the Department of Geography.

Requirements for conferral of the LL.M. degree include the satisfactory completion of 40-45 quarter credits of course work and research, of which a minimum of 15 must be in the School of Law.

ECONOMICS

Natural Resources Utilization and Public Policy

ENGINEERING

Social Management of Technology
Ocean Engineering Systems Design
Marine Technology Affairs
Systems Engineering Fundamentals
Man and Pollution of his Environment

FISHERIES

Fisheries Sciences

GEOGRAPHY

Geography of Transportation

LAW

Natural Resources
International Law of the Sea
Ocean Resources Seminar
Admiralty
Directed Research

PUBLIC POLICY

Policy Development and Administration: Natural Resources

OCEANOGRAPHY

Marine Sciences and Law

Persons interested in applying for the LL.M. program should do so early in the school year because the deadline for completed applications occurs in the spring quarter. For information and application forms, write:

University of Washington
School of Law
Graduate Program Adviser
Seattle, Washington 98195

WASHINGTON TECHNICAL INSTITUTE
Washington, D.C. 20008

Washington Technical Institute has an Environmental Science Department which has a program of technician training in marine science technology. The principal teaching facility is the main campus at 4100 Connecticut Avenue, N.W., Washington, D.C.

The field stations for research, laboratory and ship training are located at Wallops Island, Virginia, and at Lewes, Delaware. Courses of study at these two field stations are offered throughout the summer by the Marine Science Consortium, of which Washington Technical Institute is a member. Equipment use and handling is taught aboard the R/V Annandale, a 90-foot vessel, and aboard Boston Whalers and catamarans. Equipment includes salinometers, spectrophotometers, STD recorders, and microscopes. Scuba diving is offered during the summer at the main campus.

An Associate of Applied Science (AAS) degree is offered.

The following courses are offered in conjunction with the above program:

CHEM	General Chemistry I, II	4
EDPM 100	Data Processing	3
MATH 111, 112, 113	Technical Mathematics I, II, III	3
PHYS	Physics I, II, III	4
MARS 100	Science of Man's Environment	4
MARS 124	Instrumentation	5
MARS 151	Biological Oceanography	6
ELEC 101, 102	Basic Electronics I, II	4
MARS 252, 253	Physical Oceanography I, II	3
MARS 265, 266	Environmental Statistics I, II	3
MARS 220	Data Handling and Analysis	4
MARS 236	Microbiology	4
MARS 251	Geological Oceanography	6

The instructional staff for the courses listed above consists of the following:

MARINE BIOLOGY

Jones, A.J., Ph.D., Assistant Professor

EARTH SCIENCE

Kakovitch, T., M.S., Assistant Professor

OCEANOGRAPHY

Berryman, M.S., J.D., Professor

To obtain additional information, address all inquiries directly to:

Prof. M.S. Berryman, Chairman
Environmental Science Department
Building 1, Room 108
Washington Technical Institute
4100 Connecticut Avenue, N.W.
Washington, D.C. 20008

WEBB INSTITUTE OF NAVAL ARCHITECTURE
Glen Cove, New York

The college offers a course of study in naval architecture and marine engineering to train and educate young men who are interested in the design and construction of ships.

Specialized facilities include a 93-foot long model basin with wave maker, a flow channel, a marine engineering laboratory which includes operating components of commonly encountered marine machinery and a time-sharing computer facility.

The Bachelor of Science in Naval Architecture and Marine Engineering is offered by the institute.

The following courses are offered in conjunction with the above program:

Vibrations
Practical Naval Architecture I
Practical Naval Architecture II
Ship Resistance and Propellers I
Ship Resistance and Propellers II
Theoretical Naval Architecture I
Theoretical Naval Architecture II
Theorectical Naval Architecture III
Theory of Structures
Ship Design I & II
Marine Engineering I
Marine Engineering II
Marine Engineering III
Marine Engineering IV
Marine Engineering V
Hydrodynamics
Fluid Mechanics

The instructional staff for the courses listed above consists of the following:

Bond, Thomas H., M.E.E., Professor of Electrical Engineering
Hamlin, Norman A., S.M., Research Professor of Naval Architecture
Hoffman, Dan, B.Sc., Research Associate
Holm, Jens T., M.S., Professor of Marine Engineering
Lewis, Edward V., M.S., Research Professor of Naval Architecture
Nevitt, Cedric R., S.M., Professor of Naval Architecture
Ward, Lawrence W., D.Sc., Professor of Engineering

To obtain further information, address all inquiries directly to:

W.A. Brockett, Rear Admiral, USN (Ret.)
President
Webb Institute of Naval Architecture
Glen Cove, New York 11542

UNIVERSITY OF WEST FLORIDA
Pensacola, Florida 32504

This upper division state university which opened in 1967 offers marine science-oriented courses on its 1,000-acre main campus located at the north end of Escambia Bay. The main focus for marine science affairs is the Faculty of Biology, housed in a new teaching and research facility. This facility has shops, equipment and wet rooms capable of managing more than 2,500 gallons of running sea water in closed systems. Through the cooperation of the Environmental Protection Agency, the university maintains a laboratory field station on Little Sabine Island in Santa Rosa Sound. The university has three 14-foot "whaler" type craft; the Argonaut, a 23-foot vessel equipped with fathometer, davit and winch, and the Sailfisher, a 28-foot inboard diesel which is being outfitted with a light winch and boom for bay use. Through the state university system Institute of Oceanography, our students and faculty have opportunity for studies in the Gulf of Mexico and Caribbean Sea.

The marine biology program is further supported by individual student research space and a variety of items of marine science equipment such as nets, seines, trawls, grabs and dredges, portable salinometers, oxygen meters, pH meters, current meters, transmissometer and gravity corer, sediment sieves, Scuba equipment and compressor. The laboratory facility has a complete suite of equipment for chemical oceanography.

The following degrees in marine sciences are offered by the university:

M.S. in Biology (Estuarine Studies). The Faculty of Biology offers graduate programs leading to the M.S. and M.S. in Teaching degrees. While the M.S. program is oriented to the study of estuarine systems, many other areas of biology are represented by the faculty and individually oriented investigations are encouraged. Applicants to either graduate program must hold a bachelor's degree in some field of biological science from an accredited institution. Applicants holding the bachelor's degree in a field other than biology will be considered for admission to either program by special request. As a member of the state university system, the student must have a 3.0 for the last 90 hours or a combined score of 1000 on the graduate entrance examination.

In order to be advanced to candidacy for the M.S. or M.S. in Teaching degrees in biology, the student must meet certain requirements, including passage of a comprehensive examination in biology.

Master of Science. All candidates for the M.S. degree with thesis are required to complete a minimum of 45 quarter hours of approved credit. Of these, not less than 30 may be senior/graduate courses and not less than six nor more than 10 quarter hours may be from BY 599 or 699. Fifty per cent of the total hours must be graduate-level.

The matter of course selection is up to the student and his graduate advisory committee. If, upon review of the applicant's undergraduate record, a deficiency is noted by the student's graduate advisory committee, this deficiency must be remedied with a grade of "B" or better and without credit.

In addition to course work, the student's program may require demonstration of a reading knowledge of scientific french, german or russian. A written thesis and oral defense must be completed in a manner satisfactory to the student's graduate advisory committee.

Fifteen M.S. degrees have been awarded since 1969.

B.S. in Biology (Marine Sciences). The prospective biologist or marine scientist should have a well-balanced general education in the humanities and social sciences. Consequently, the candidates for admission to the bachelor's degree program in biology at this university would be well prepared if they have completed the following courses: humanities (including english composition), social sciences, mathematics (through trigonometry), chemistry (through organic), physics (with laboratory) and biology.

General program requirements: A student graduating from study with the Faculty of Biology will receive a B.S. degree in biology when he or she has met the following departmental requirements: an average of greater than 2.0 in all biology subjects taken, completion of the assigned biology core courses with no grade less than a "C", and completion of at least two academic terms of general organic chemistry and a course in statistics.

In addition to the core, the student must select an additional 20 hours of seminar and course work and at least three hours of directed study all involving a marine orientation.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

310	Molecular Biology	6
311	Genetics	5
312	Developmental Biology	5
340	Microbiology	5
341	Cell Biology	5
342	Human Genetics and Evolution	5
343	Principles of Evolution	5
344	Introduction to Oceanography	5
345	Natural History of Marine Organisms	5
359	Introduction to Medical Technology	5
360-379	Seminar	1-5
400	Special Methods in Biology	3
410	Environmental Biology	6
411	Organismic Biology	6
440	Marine Invertebrate Zoology	5
441	Marine Invertebrate Zoology	5
444	Marine Vertebrate Zoology	5
446	Aquatic Botany	5
447	Applied Microbiology	5
480-487	Medical Technology	4-5
499	Directed Study	1-5

SENIOR/GRADUATE

500	Medical and Public Health Bacteriology	5
501	Introduction to Endocrinology	5
502	Intermediary Metabolism	5
503	Advanced Genetics	5
504	Biology of Animal Parasites	5
505	Enzymology	3
521	Estuarine Biology	6
522	Biological Oceanography	5
530	Plankton Biology	5
531	Biology of Algae	5
532	Scientific Illustrations	3
550	Development of Marine Invertebrates	5
551	Endocrinology of Marine Organisms	5
560-579	Senior/Graduate Seminar	1-5
599	Directed Study	1-3

GRADUATE

FACULTY OF BIOLOGY

600	Introduction to Ethology	5
601	Biology of Molluscs	5
602	Biology of Crustacea	5
603	Biology of Echinoderms	5
610	Molecular Genetics	4
611	Quantitative Ecology	5
612	Ecological Adaptations	5
613	Ecological Energetics	5
621	Chemistry of Marine Natural Products	5
622	Microbial Genetics	5
623	Freshwater and Marine Microbiology	5
630	Biology of Fishes	5
640	Biology of Vascular Plants	4
645	Aquaculture	5
652	Comparative Animal Physiology	5
672-690	Graduate Seminar	1-5
699	Thesis	1-10

The instructional staff for the courses listed above consists of the following:

FACULTY OF BIOLOGY

Baylis, J.R., Ph.D., Associate Professor
Butler, P.A., Ph.D., Faculty Associate
Chaet, A.B., Ph.D., Provost and Professor
Collard, S.B., Ph.D., Assistant Professor
D'Asaro, C.N., Ph.D., Associate Professor
Duke, T.W., Ph.D., Faculty Associate
Edmisten, J.A., Ph.D., Associate Professor
Hopkins, T.S., Ph.D., Chairman and Associate Professor
Moshiri, G.A., Ph.D., Assistant Professor
Rao, K.R., Ph.D., Assistant Professor
Reid, R.D., Ph.D., Professor of Microbiology
Riehm, J.P., Ph.D., Associate Professor
Walsh, G.E., Ph.D., Faculty Associate
Winter, P.A., Ph.D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Alfred B. Chaet
Provost Gamma College
The University of West Florida
Pensacola, Florida 32504

WESTERN MICHIGAN UNIVERSITY
Kalamazoo, Michigan 49001

Western Michigan University offers opportunities for graduate students in either biology or geology to concentrate in aquatic sciences. This may be in the Great Lakes or in marine waters. Active teaching and research programs in both areas are in progress. Excellent laboratory facilities are available in both departments. Opportunities for summer field courses exist in addition to the usual on-campus studies. The university is a member of two consortiums, each of which has marine-oriented summer programs. These are Central States Universities, Inc., and Associated Universities for International Education. The latter operates out of St. John's College in Belize, British Honduras.

The following degrees are offered. Concentrations in marine-related aspects of either are possible.

1. M.A. in Biology. Requirements: 30 credit hours in biology and related areas and completion and defense of a thesis.

2. M.A. in Geology. Requirements: 30 credit hours (as many as nine hours may be outside the department), completion of a thesis, and a comprehensive oral examination.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Biol 301	Ecology	3
Geog 225	Introduction to Meteorology and Climatology	4
Geol 300	Oceanography	3
Geol 444	Environmental Geology	3

UNDERGRADUATE AND GRADUATE

Biol 528	Biology of Nonvascular Plants	3
Biol 541	Invertebrate Zoology	3
Biol 543	Protozoology	3
Biol 553	Limnology	3
Biol 555	Physiological Ecology	3
Biol 557	Tropical Marine Ecology	3
Biol 598	Reading in Biology	1-3
Biol 599	Independent Studies in Biology	1-4
Geol 502	Special Problems in Earth Science	1-3
Geol 533	Invertebrate Paleontology	4
Geol 535	Sedimentation and Stratigraphy	4

GRADUATE

Biol 601	Special Investigations	2-6
Biol 602	Seminar (various areas)	2-6
Geol 620	Marine Geology	3
Geol 634	Research in Geology	1-4
Geol 650a	Geochemistry	3
Geol 650b	Hydrogeology	3
Geol 650c	Sedimentary Petrology	3
Geol 650e	Coastal Sedimentation	3

To obtain further information, address all inquiries directly to:

Richard A. Davis, Jr.
Associate Professor
Department of Geology
Western Michigan University
Kalamazoo, Michigan 49001

UNIVERSITY OF WISCONSIN
Madison, Wisconsin 53706

The University of Wisconsin-Madison has a varied Great Lakes and oceanographic research and education program. The focus of the program is in the Marine Studies Center, but faculty throughout the campus participate in the program.

Several research vessels are owned and operated by the University of Wisconsin. The 41-foot R/V Aquarius is operated by the Marine Studies Center of the university and is based at Sturgeon Bay. The 62-foot Neeskay is operated on Lake Michigan by the Center for Great Lakes Studies at the University of Wisconsin-Milwaukee. Both these vessels are specifically outfitted for oceanographic survey work, such as bottom coring, hydrographic casts, BT surveys, dredging and trawling, and chemical, physical, biological and meteorological observation. The 30-foot Limnos is based on Lake Mendota at Madison. Specially outfitted pontoon boats and numerous smaller boats with outboards are available for lake study. Researchers at the university have also used Army, Navy and Coast Guard ships.

A number of coordinated ship-aircraft operations have been performed with the aid of research aircraft from the Research Aviation Facility of the National Center for Atmospheric Research, the Wisconsin State Division of Highways, and the Remote Sensing Center of the Institute for Environmental Studies.

The new Meteorology and Space Sciences Building houses physical oceanography laboratories as well as the offices of the Marine Studies Center and the Sea Grant Program. The Engineering Research Building has an entire floor devoted to ocean engineering and is the present home of the Marine Research Laboratory, the natural science arm of the Marine Studies Center.

The Laboratory of Limnology has facilities for paleo- and latitudinal-limnology, hydrobotany, microbiology, and water chemistry, as well as labs for the study of behavior and physiology of fishes, zooplankton, physical limnology and fishery biology. The Limnology Laboratory also maintains a year-round laboratory facility at Trout Lake. This facility is a well-equipped biological field station in the lake district in northern Wisconsin. A wide variety of lake types is available for study near the laboratory.

The major computer facility, housed in the university computer center, is the Univac 1108, along with a Univac 9300 remote terminal. Wisconsin's first sea-going computer, a Datacraft 6024/3, is now completely operational. This device will provide digital data acquisition processing at sea, giving the researcher immediate feedback about his experiments. Datacraft is located presently in the Geophysics Research Laboratory and is ready for use at sea.

The university's main reference facility, the Memorial Library, catalogues over two million volumes and the new Helen C. White undergraduate library was recently completed. In addition, there are departmental libraries in biology, engineering, earth sciences (geography, geology, meteorology, oceanography), life sciences, limnology and physical sciences.

In addition to specific oceanographic facilities, each department has complete laboratory facilities of its own, many of which are invaluable aids to marine research. These include the Twenhofel Geological Laboratory, Geophysical and Polar Research Center, geophysical and geochemical facilities, ocean engineering laboratories, and the Water Chemistry Laboratory.

The oceanography and limnology graduate program offers the Ph. D. and M. S. in Oceanography and Limnology. A graduate minor in oceanography and limnology is also offered. The program is administered by the interdepartmental committee on oceanography and limnology. A student in the program is required to have had mathematics through calculus and one year each in chemistry, biology and physics. In addition, the student is required to take advanced work in marine and aquatic related subjects in two or more departments and to specialize in a particular aspect of oceanography and limnology, i.e., physical, chemical, geological or biological. Study plans will be individually tailored for each student by a committee of three professors. At least one semester of marine experience is required.

The following courses are offered in conjunction with the above program:

DEPARTMENT OF BACTERIOLOGY

303	General Microbiology	4
320	Advanced General Microbiology	3
326	Physiology of Microorganisms	3-4
725	Microbial Ecology and Physiology	5
726	Advanced Microbial Physiology	3
727	Laboratory Techniques and Microbial Physiology	1
730	Taxonomy and Nomenclature of Bacteria	4
731	Seminar	1

DEPARTMENT OF BOTANY

260	Introduction to Ecology	3
330	Algae	3
460	General Ecology	3
490	Physiology and Ecology of Aquatic Plants for Non-Biologists	2
801	Advanced Plant Ecology	3

802	Advanced Plant Ecology	3
825	Ecological Methods	3
950	Seminar in Plant Ecology	1

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING (INCLUDING WATER CHEMISTRY)

406	Remote Sensing of the Environment	3
602	Hydrodynamics	3
612	Open Channel Hydraulics	3
621	Hydrology	3
622	Water Resources Engineering	3
661	Ocean Dynamics	2
662	Dynamical Oceanography	2
664	Technology of Ocean Operations	3
665	Ocean Environment	3
669	Ocean Engineering Seminar	1
676	Diffusion and Dispersion	3
863	Free Surface Flow (Water Waves)	3
960	Hydraulic Engineering and Fluid Mechanics Seminar	1

WATER CHEMISTRY

644	Water Chemistry	3
645	Water Analysis - Intermediate	3
646	Marine Chemistry	2
647	Water Supply and Pollution Control	2
665	Ocean Environment	1-3
679	Special Topics in Water Chemistry	--
770	Advanced Water Chemistry	3
771	Advanced Techniques of Water Analysis	3
772	Advanced Techniques of Water Analysis II	3
773	Organic Water Chemistry	2
774	Problems in Oceanography	3
962	Water Chemistry Seminar	1

DEPARTMENT OF ENTOMOLOGY

532	Aquatic Insects	3

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

130	Survey of Oceanography	3
135	Environmental Geology	3
327	X-Ray Crystallography	3
525	Micropaleontology	3
526	Micropaleontology	3
533	Geochemistry of Sediments	3
535	Physical Aspects of Sedimentation	2-3
537	Geological Oceanography	3
538	Recent Marine Sediments	3
652	Wave Propagation	3
663	Geophysical Field and Interpretation Methods	3
671	Marine Geophysics	3
774	Problems in Oceanography	3
777	Sea Floor Geological Processes	3
977	Seminar in Sedimentation and Geological Oceanography	2

DEPARTMENT OF METEOROLOGY

130	Survey of Oceanography	3
403	Micrometeorology	3
460	Physical Oceanography	3
461	Physical Oceanography II	3
501	General Meteorology	5
502	General Meteorology II	5
551	Geophysical Fluid Dynamics	3
662	Dynamic Oceanography	2
663	Oceanic Density Motions	2
774	Problems in Oceanography	3
861	Problems of Viscous Flow	2-3
862	Problems of Turbulent Flow	2-3
960	Seminar: Oceanography	1-2

DEPARTMENT OF POLITICAL SCIENCE

504	Science and Government	3

DEPARTMENT OF URBAN/REGIONAL PLANNING

449	Government and Natural Resources	3
821	Resource Policy Issues: Regional and National	2-3
822	Resource Policy Issues: Regional and National	2-3
865	Water Resource Institutions and Policies	3
960	Seminar in Planning: Impact of Urbanization on Natural Resources Management	2-4
965	Seminar in River Basin Planning	2-3
966	Seminar in Water Resources Planning	2-3

DEPARTMENT OF ZOOLOGY

300	General Invertebrate Zoology	3
500	Ecology	3
510	Ecology of Fishes	3
515	Limnology -- Conservation of Aquatic Resources	2
518	Hydrobiology	3
615	Biology of Aquatic Populations	3
955	Seminar: Limnology	1

SCHOOL OF LAW

812	Admiralty Law	--
827	International Law	--
845	Water Rights Law	2
918	International Law (Seminar)	2
919	International Organizations	2
966	Water Resource Management	--

The instructional staff for the courses listed above consists of the following:

DEPARTMENT OF BACTERIOLOGY

Brock, Thomas, Ph. D., Professor
Brill, Winston, Ph. D., Associate Professor
Ensign, J. C., Ph. D., Professor
Hanson, Richard, Ph. D., Professor
McCoy, Elizabeth, Ph. D., Professor
Pate, Jack, Ph. D., Associate Professor
Wilson, J. B., Ph. D., Professor

DEPARTMENT OF BOTANY

Adams, Michael, Ph. D., Associate Professor
Allen, Timothy, Ph. D., Assistant Professor
Cottam, Grant, Ph. D., Professor
Gerloff, Gerald C., Ph. D., Professor
Loucks, Orie L., Ph. D., Professor
Woelkerling, William, Ph. D., Assistant Professor

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING (INCLUDING WATER CHEMISTRY)

Armstrong, David E., Ph. D., Associate Professor
Clapp, James L., Ph. D., Professor
Hoopes, John A., Ph. D., Professor
Huff, Dale D., Ph. D., Associate Professor
Lee, G. Fred, Ph. D., Professor
Lenz, Arno T., Ph. D., Professor
Monkmeyer, Peter L., Ph. D., Professor
Saul, William E., Ph. D., Professor
Villemonte, James R., Ph. D., Professor

DEPARTMENT OF ENGINEERING MECHANICS

Huang, T. C., Ph. D., Professor

DEPARTMENT OF ENTOMOLOGY

Boush, Mallory G., Ph. D., Professor
Hilsenhoff, William L., Ph. D., Professor
Matsumura, Fumio, Ph. D., Professor

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

Clay, Clarence S., Ph. D., Professor
Clark, David L., Ph. D., Professor
Meyer, Robert P., Ph. D., Professor
Moore, J. Robert, Ph. D., Professor
Steinhart, John, Ph. D., Professor

DEPARTMENT OF MECHANICAL ENGINEERING

Harker, Ralph J., M.S., Professor
Livermore, Donald F., Ph. D., Professor
Seirig, Ali A., Ph. D., Professor

DEPARTMENT OF METEOROLOGY

Bryson, Reid A., Ph. D., Professor of Meteorology
Green, Theodore, Ph. D., Associate Professor of Civil and Environmental Engineering and Meteorology
Hastenrath, Stefan L., Ph. D., Professor of Meteorology
Lettau, Heinz, Ph. D., habil., Professor of Civil and Environmental Engineering and Meteorology
Ragotzkie, Robert A., Ph. D., Professor of Meteorology
Stearns, Charles R., Ph. D., Associate Professor of Meteorology
Young, John A., Ph. D., Associate Professor of Meteorology

DEPARTMENT OF MINERALS AND METALS

Heins, Robert W., Ph. D., Associate Professor of Mining Engineering

DEPARTMENT OF NUCLEAR ENGINEERING

Huston, Norman E., Ph. D., Professor

DEPARTMENT OF POLITICAL SCIENCES

Kay, David, Ph. D., Associate Professor

DEPARTMENT OF URBAN/REGIONAL PLANNING

Clarenbach, Fred A., Ph. D., Professor

DEPARTMENT OF ZOOLOGY

Dodson, Stanley, Ph. D., Assistant Professor
Hasler, Arthur D., Ph. D., Professor
Magnuson, John J., Ph. D., Associate Professor
Passano, Leonard M., Ph. D., Professor
Porter, Warren, Ph. D., Associate Professor

SCHOOL OF LAW

Baldwin, Gordon B., LL. B., Professor
Bilder, Richard, LL. B., Professor
Bunn, George, LL. B., Professor
MacDonald, James B., J. D., Professor
Runge, Carlisle, J. D., Professor
Tuerkheimer, Frank M., LL. B., Visiting Associate Professor
Zile, Ziqurds, LL. B., Professor

To obtain further information, address all inquiries directly to:

Professor Robert A. Ragotzkie
Chairman, Oceanography and Limnology Committee
Marine Studies Center
1225 West Dayton Street
Madison, Wisconsin 53706

UNIVERSITY OF WISCONSIN-MILWAUKEE
Milwaukee, Wisconsin 53201

Located at a major Lake Michigan port, UWM has developed substantial capabilities for instruction and research on the Great Lakes. In addition to the basic marine-related curriculum noted below, the emphasis here is on the physics, biology, geology and socio-technological management of the Great Lakes environment, now generally regarded as part of the nation's coastal zone.

An inter-departmental Center for Great Lakes Studies serves as a university-wide facility and coordinating focus for marine and related research, particularly at the graduate level. The center's facilities include: a well-equipped 65-foot research vessel R/V Neeskay; chemical, biological and mobile field laboratories; and a complement of standard and specialized equipment for field sampling and measure. Recent acquisition of a modern building (120, 000 square feet) with a deepwater dock (1, 200 feet) in Milwaukee Harbor will provide a home and shore base for all of the center's activities and marine access for the University of Wisconsin system as a whole.

Faculty members work on a part-time basis in the center; and, conversely, the center's staff work in the departments with part-time appointments, teaching assignments and supervision of graduate research, including the Sea Grant Program and NOAA's International Field Year on the Great Lakes.

Separate degrees are not offered in the marine sciences, but a student may take a degree in the biological, physical or earth sciences with a concentration in marine sciences. Degree programs that offer work in marine sciences are M. S. in botany, engineering and applied science, geography (meteorology), geological sciences, physics and zoology. Ph. D. programs include botany, geography (meteorology) and physics. Zoology offers a Ph. D. with the Madison campus.

The following courses are offered in connection with the above programs:

UNDERGRADUATE

208-110	Algae and Aquatic Problems	2
416-120	Man's Physical Environment	4
416-121	Introduction to Land Form, Water and Soil Forming Process	3
416-125	Survey of Physical Geography	3
422-150	Introduction to Ocean Sciences	3
640-102	Weather and Climate	5
970-100	Survey of Zoology	3
970-101	Animal Biology	5

GRADUATE

208-330	Morphology of Algae	3
208-430	Marine Algae	2
330-628	Geophysical Fluid Dynamics I	3
330-728	Geophysical Fluid Dynamics II	3
416-412	Climate of the Earth	3
416-414	Water Resources	3
416-842	Long Range Forecasting and Climate Modification	3
422-460	Oceanography	3
422-461	Oceanographic Laboratory	2
422-463	Hydrogeology	3
422-534	Sedimentology	4
422-537	Marine Geology	2
422-662	Geophysical Exploration; Marine Laboratory	2
422-667	Marine Geophysics	3
422-737	Marine Geology	2
422-961	Seminar in Sedimentology	3
422-971	Seminar in Geophysics	2
422-973	Seminar in Geological Oceanography	3

640-460	Air Pollution Meteorology	3
640-470	Meteorological Oceanography	4
640-512	Turbulent Diffusion in the Atmosphere and Water Basins	3
970-301	Invertebrate Zoology	4
970-511	Icthyology	3
970-516	Limnology Lecture	2
970-517	Limnology Laboratory	1
970-518	Fishery Biology	3
970-611	Recent Advances in Limnology and Oceanography	2
970-710	Paleolimnology	2
970-716	Lake and Ocean Dynamics: Particular Reference to the Great Lakes	2
970-717	Field Methods and Problems in Great Lakes Research	2
970-730	Studies of Marine Fishes	3
970-899	Advanced Independent Studies in Zoology	3
970-928	Seminar: Aquatic Biology	2
970-990	Graduate Research	3

The instructional staff for the courses listed above include the following:

BOTANY

Blum, John L., Ph. D., Professor

ENERGETICS

Rao, D. B., Ph. D., Associate Professor

GEOGRAPHY

Borowiecki, Barbara, Ph. D., Professor
Miller, David H., Ph. D., Professor
Slovenken, Ruth D., M. S., Assistant Professor

GEOLOGICAL SCIENCE

Lasca, Norman P., Ph. D., Associate Professor
Paull, Richard A., Ph. D., Professor
Pirie, R. Gordon, Ph. D., Associate Professor
Wold, Richard J., Ph. D., Associate Professor

METEOROLOGY

Bayer, Karel, RNDr., Associate Professor
Lyons, W. A., Ph. D., Assistant Professor

ZOOLOGY

Beeton, Alfred M., Ph. D., Professor
Mortimer, Clifford H., Ph. D., D. Sc. FRS, Distinguished Professor
Norden, Carroll R., Ph. D., Professor

To obtain further information, address all inquiries directly to:
Dr. Richmond B. McQuistan, Dean
Graduate School
The University of Wisconsin-Milwaukee
Milwaukee, Wisconsin 53201

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

The institution is located in Woods Hole, a small village at the southwest corner of Cape Cod, 80 miles south of Boston. The location of the institution combines the advantage of close proximity to the Marine Biological Laboratory and the laboratory of the National Marine Fisheries Service, and of the exceptional opportunities for illustrative investigations in the major divisions of oceanography that is afforded by the neighboring waters. Currently in Woods Hole the institution operates four principal research laboratories, a number of smaller buildings for support services, and waterfront facilities for tending a fleet of four sea-going research vessels, a deep submergence research vehicle and support vessel, and a number of small boats. A fifth ship, a medium-sized research vessel of 179 feet is expected to be added to the fleet during 1973. The laboratories, well-equipped for research in biological, chemical, and physical oceanography, marine geology and marine geophysics, and in ocean engineering, are backed up by available computer services through the institution's own Information Processing Center, and the combined library resources of the institution, Marine Biological Laboratory and the National Marine Fisheries Service station.

Development of a major new laboratory and office complex is presently in construction about two miles from the center of Woods Hole. Special research facilities for chemotaxis studies and a Data and Earth Sample Center are already in operation. An Environmental Systems Laboratory will also be operational.

Graduate degree programs at the Woods Hole Oceanographic Institution are carried out as a cooperative effort with several universities. Students may register in the Joint Program in Oceanography/Ocean Engineering conducted with the Massachusetts Institute of Technology for programs of study and research leading to a joint doctoral degree - a single document issued jointly by both institutions. The Joint Program in Oceanography/Ocean Engineering is administered by both institutions and constitutes the major pathway for the majority of students entering the graduate degree program at Woods Hole. Programs of study and research leading to a doctoral degree in oceanography awarded by the Woods Hole Oceanographic Institution alone, are offered for the student whose area of interest is not best served by the joint program. Through cooperative agreements with Harvard University and Brown University, students registered for a graduate degree at Woods Hole may enroll for course work and related study at Harvard or Brown in accordance with the usual cross-registration procedures. A less formal arrangement for cross-registration is in effect with the departments of Biology and Geology and Geophysics at Yale University.

The following degrees are offered:

1. Ph. D. and Sc. D. in Oceanography, offered jointly by W. H. O. I. and M. I. T..
2. Ph. D. in Oceanography offered by the Woods Hole Oceanographic Institution.

Students in either doctoral degree program may concentrate in one or more of the following areas: biological oceanography, chemical oceanography, marine geology, marine geophysics or physical oceanography.

The usual steps to a degree are: enter the program in the summer preceding the fiest academic year and work as a research assistant in Woods Hole; follow an individually designed program of advanced study and research in preparation for a general examination to be taken before the third year (the general examination tests for a comprehensive knowledge of oceanography and ability to identify and explore research problems); meet the recommended language requirements (not required in the joint program) of a reading ability of the scientific literature in two acceptable foreign languages, and submit a dissertation on significant original theoretical or experimental research and conduct an oral defense of the thesis.

Each student formulates, with the assistance of academic advisors (one from each institution), a program of studies usually involving subjects, seminars and research activities. There are no formal course requirements, but each degree candidate is expected to gain some degree of familiarity with the principal areas of oceanography, in addition to demonstrating a thorough knowledge of at least one major field of specialization. A student's place of

residence is determined by his outlined program of study and research.

Following are the few courses offered at Woods Hole on a regular basis. In addition, numerous seminars and directed studies are offered based on the individual needs of the students: Biological Oceanography, Biological Oceanography Advanced Topics Seminars, Chemical Oceanography, Chemical Oceanography Advanced Topics Seminars, Introduction to Marine Geology & Geophysics, Marine Geology and Marine Geophysics Advanced Topics Seminars, Introduction to Physical Oceanography, The General Circulation of the Oceans and Physical Oceanography Advanced Topics Seminars.

Members of the Resident Scientific and Technical Staff available as instructors, research advisors and thesis supervisors:

DEPARTMENT OF BIOLOGY

Backus, Richard H., Bioligist, Senior Scientist and Chairman
Carey, Francis G., Physiologist and Associate Scientist
Carpenter, Edward J., Biologist and Assistant Scientist
Grassle, J. Frederick, Biologist and Assistant Scientist
Grice, George D., Zoologist and Associate Scientist
Guilllard, Robert R.L., Botanist and Associate Scientist
Haedrich, Richard L., Biologist and Associate Scientist
Harbison, G. Richard, Biologist and Assistant Scientist
Hulburt, Edward M., Biologist and Associate Scientist
Jannasch, Holger W., Microbiologist and Senior Scientist
Kerfoot, William, Biologist and Assistant Scientist
Mather, Frank J. III, Biologist and Associate Scientist
Remsen, Charles C., Microbiologist and Associate Scientist
Rowe, Gilbert T., Marine Biologist and Assistant Scientist
Ryther, John H., Marine Ecologist and Senior Scientist
Sanders, Howard L., Biologist and Senior Scientist
Scheltema, Rudolph S., Biologist and Associate Scientist
Smith, Kenneth L., Jr., Biologist and Assistant Scientist
Stegeman, John J., Biologist and Assistant Scientist
Teal, John M., Biologist and Senior Scientist
Tenore, Kenneth R., Biologist and Assistant Scientist
Tuttle, Jon H., Microbiologist and Assistant Scientist
Vacarro, Ralph F., Biologist and Associate Scientist
Watson, Stanley W., Microbiologist and Senior Scientist
Wiebe, Peter H., Zooplankton Biologist and Assistant Scientist

DEPARTMENT OF CHEMISTRY

Atema, Jelle, Neurobehaviorist and Assistant Scientist
Blumer, Max, Organic Geochemist and Senior Scientist
Bowen, Vaughan T., Geochemist and Senior Scientist
Brewer, Peter G., Geochemist and Associate Scientist
Degens, Egon T., Geochemist and Senior Scientist
Deuser, Werner G., Geochemist and Associate Scientist
Farrington, John W., Organic Geochemist and Assistant Scientist
Frew, Nelson M., Chemist and Assistant Scientist
Gagosian, Robert B., Organic Chemist and Assistant Scientist
Harvey, George R., Organic Chemist and Associate Scientist
Hunt, John M., Organic Chemist and Senior Scientist and Chairman
Sayles, Frederick L., Geochemist and Assistant Scientist
Spencer, Derek W., Geochemist and Senior Scientist
Thompson, Geoffrey, Geochemist and Associate Scientist
Todd, John, Ethologist and Assistant Scientist
Zafiriou, Oliver C., Chemist and Assistant Scientist

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

Beckerle, John C., Physicist and Associate Scientist
Berggren, William A., Micropaleontologist and Senior Scientist
Bowin, Carl O., Geologist, Geophysicist and Associate Scientist
Bryan, Wilfred B., Petrologist and Associate Scientist
Bunce, Elizabeth T., Geophysicist and Associate Scientist
Emery, K. O., Marine Geologist and Senior Scientist
Haq, Bilal Ul, Micropaleontologist and Assistant Scientist
Heirtzler, James R., Geophysicist and Senior Scientist and Chairman
Hollister, Charles D., Marine Geologist and Associate Scientist
Honjo, Susumu, Paleontologist-Geologist and Associate Scientist
Hoskins, Hartley, Geophysicist and Research Associate
Johnson, David A., Sedimentologist, Micropaleontologist and Assistant Scientist
Luyendyk, Bruce P., Geophysicist and Assistant Scientist
Knott, Sydney T., Hydroacoustic Engineering and Technical Specialist
Manheim, Frank T., Geochemist and Research Geologist, U.S. Geological Survey
Meade, Robert H., Geologist and Research Hydrologist, U.S. Geological Survey
Milliman, John D., Marine Geologist and Associate Scientist
Phillips, Joseph D., Geophysicist and Associate Scientist
Ross, David A., Geological Oceanographer and Associate Scientist
Uchupi, Elazar, Geologist and Associate Scientist
Vine, Allyn, Oceanographer and Senior Scientist
Von Herzen, Richard P., Geophysicist and Associate Scientist
Wall, David, Micropaleontologist and Associate Scientist

DEPARTMENT OF OCEAN ENGINEERING

Berteaux, Henri O., Engineering Physicist and Research Specialist
Dexter, Stephen C., Metallurgist and Assistant Scientist
Hays, Earl E., Physicist and Senior Scientist and Chairman
Mavor, James W., Jr., Mechanical Engineer and Research Specialist
McElroy, Paul T., Physicist and Assistant Scientist
Porter, Robert P., Electrical Engineer and Assistant Scientist
Rainnie, William O., Jr., Oceanographic Engineer and Research Specialist
Rosenfeld, Melvin A., Geologist and Senior Scientist
Smith, Woollcott, Statistician and Research Associate
Spindel, Robert C., Electrical Engineer and Assistant Scientist
Williams, Albert J., III, Physicist and Assistant Scientist

DEPARTMENT OF PHYSICAL OCEANOGRAPHY

Briscoe, Melbourne G., Fluid Physicist and Assistant Scientist
Bunker, Andrew W., Meteorologist and Associate Scientist

Chase, Joseph, Meteorologist/Physical Oceanographer and Associate Scientist
Ewing, Gifford C., Oceanographer and Senior Scientist
Fofonoff, Nicholas P., Oceanographer and Senior Scientist
Fuglister, Frederick C., Physical Oceanographer and Senior Scientist
Katz, Eli J., Physical Oceanographer and Associate Scientist
Luyten, James R., Physical Oceanographer and Assistant Scientist
Rhines, Peter B., Physical Oceanographer and Associate Scientist
Sanford, Thomas B., Physical Oceanographer and Associate Scientist
Saunders, Peter M., Physicist and Associate Scientist
Schmitz, William J., Physical Oceanographer and Associate Scientist
Simmons, William F., Physical Oceanographer and Associate Scientist
Thompson, Rory, Physical Oceanographer and Associate Scientist
von Arx, William S., Oceanographer and Senior Scientist
Voorhis, Arthur D., Physical Oceanographer and Associate Scientist
Warren, Bruce A., Physical Oceanographer and Associate Scientist
Webster, Ferris, Physical Oceanographer and Senior Scientist and Chairman
Whitehead, John A., Jr., Physical Oceanographer and Assistant Scientist
Worthington, L. V., Physical Oceanographer and Senior Scientist
Wright, W. Redwood, Physical Oceanographer and Assistant Scientist

The program of study and research leading to graduate degrees in ocean engineering aims to lay the foundation for a career in oceanography with a specialty in oceanographic engineering. This program is conducted jointly with the M. I. T. Department of Ocean Engineering and primarily is directed at students with interests in oceanographic or oceanography-related engineering problems and those concerned with engineering in the ocean and control of the ocean and its resources.

The following degrees are offered:

1. Ocean Engineer - (professional degree) offered jointly by M. I. T. and Woods Hole. The requirements for the ocean engineer degree include the satisfactory completion of a core curriculum, achievement of the appropriate distribution and credit requirements, evidence of experience in system design or field projects, and submission of a satisfactory thesis. A student entering the program with preparation equivalent to a bachelor's degree in the M. I. T. Ocean Engineering Department may ordinarily complete the requirements for the ocean engineer degree in three years of full-time study. The entering student is strongly encouraged to enroll in June and spend the first summer at Woods Hole taking an introductory course in oceanographic systems, involving both field and laboratory experience. The first three academic year terms will normally be spent at M. I. T. in pursuit of the more fundamental graduate courses, and the second summer and following academic year will be spent at W. H. O. I. in pursuit of oceanographic engineering and oceanography courses, seminars and research activities.

2. Ph. D. or Sc. D. in Ocean Engineering - offered jointly by M. I. T. and Woods Hole. The doctoral degree normally requires four years of graduate study and encompasses the satisfactory completion of a core curriculum, passage of a general examination, independent research on a topic with related additional course work, the reporting of this research in a dissertation and oral defense of this dissertation. The doctoral candidate will normally follow the same pattern of residency at M. I. T. and Woods Hole as the ocean engineer candidate during the first two years. Following completion of course work and passage of the general examination, a student will take up residence at either institution depending on convenience to his research supervisor and/or appropriate research facilities.

Following are the few courses offered at Woods Hole on a regular basis. In addition, numerous seminars and directed studies are offered based on the individual needs of the students: Oceanographic Systems I, Oceanographic Systems II, Buoy Engineering, Oceanographic Deep Submergence Engineering, Oceanographic Instrumentation and Measurement, Deterioration of Materials in the Ocean and Statistical Inference.

For further information, contact:

A. L. Peirson, III
Assistant to the Dean of Graduate Studies
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

WORCESTER POLYTECHNIC INSTITUTE
Worcester, Massachusetts 01609

In addition to the facilities on the main campus, Worcester Polytechnic Institute (WPI) has extensive research facilities for hydraulics, fluid mechanics and related studies at Alden Research Laboratories in Holden, Mass.

WPI has close relations with oceanographic research institutions, including Woods Hole Oceanographic Institution (WHOI). Most current research is concerned with properties of nearshore and deep-ocean sediments and associated engineering involved with sampling techniques. Specialized facilities currently being utilized at WPI include a complete soil mechanics laboratory, geology laboratory, X-ray diffraction equipment, microscopy equipment, water quality laboratory, walk-in cold room, shops, materials science facilities, chemistry laboratories, life science laboratories, engineering laboratories on the main campus and at Alden Research Laboratories, and the computer center. Negotiations are now underway to acquire a parcel of oceanfront land to be utilized for nearshore research.

Since the WPI plan allows maximum program flexibility, undergraduate students are able to develop B. S. programs to meet their special interests and needs. The student can thus obtain preparation for further study in most of the marine sciences -- especially in geological, physical, chemical and biological oceanography and ocean engineering. Although formal graduate degrees are not offered in oceanography or ocean engineering, graduate students can take a program with special emphasis in marine science-related fields.

The following courses are specifically appropriate for marine-related program development considerations and others from the graduate and undergraduate offerings of the college should be explored. In addition, offerings of Worcester area consortium colleges, especially Clark University, Holy Cross College and Worcester State College, can be taken through a cross-registration arrangement.

UNDERGRADUATE

ID 1010	Introduction to Oceanography
ID 1030	Introduction to Environmental Problems
ID 2341	Geology

ENGINEERING

ES 3004	Fluid Mechanics

CIVIL ENGINEERING

CE 3040	Physical Climatology
CE 3041	Soil Mechanics
CE 3043	Marine Geology
CE 3044	Foundation Engineering

LIFE SCIENCES

LS 1001	Biological Science
LS 2002	Microbiology
LS 3001	Ecology

UNDERGRADUATE/GRADUATE

ID 4042	Geochemistry
CE 4045	Introduction to Ocean Engineering
CE 4046	Experimental Soil Mechanics
CE 4066	Stream, Lake and Estuarine Analysis
LS 4910	Molecular Biology and Modern Biochemistry
CE 540	Advanced Engineering Geology
CE 550/551	Theoretical Soil Mechanics
CE 552	Applied Soil Mechanics
CE 580	Construction Project Management
ME 561	Advanced Fluid Mechanics
ME 581	Materials Science
ME 5842	Corrosion and Corrosion Control
ME 5810	X-Ray Diffraction
ME 5812	Advanced Microstructure Analysis

The instructional staff for the courses listed above consists of the following:

CHEMICAL ENGINEERING

Sand, L. B., Ph. D., Professor

CHEMISTRY

Todd, D., Ph. D., Professor

CIVIL ENGINEERING

Chalabi, A. F., Ph. D., Professor
Hollister, C. D., Ph. D., Adjunct Professor and Associate Scientist, WHOI
Lutz, F. C., Ph. D., Assistant Professor
Sage, J. D., M. S., Associate Professor
Silva, A. J., Ph. D., Associate Professor

LIFE SCIENCES

Crusberg, T. D., Ph. D., Assistant Professor

MECHANICAL ENGINEERING

Biederman, R. R., Ph. D., Assistant Professor

PHYSICS

Bluemel, V., Ph. D., Assistant Professor

To obtain further information, address all inquiries directly to:

Dr. Armand J. Silva, Head
Department of Civil Engineering
Worcester Polytechnic Institute
Worcester, Massachusetts 01609
(617) 753-1411, ext. 294

YALE UNIVERSITY
New Haven, Connecticut 06520

Instruction in the marine sciences is offered principally in the Departments of Geology and Geophysics and Biology. There is also a joint program in marine biology with Woods Hole Oceanographic Institution, in which students may take courses or do research at either institution. An interdepartmental program in geophysics is offered by the Departments of Geology and Geophysics and Engineering and Applied Science.

The following degrees are offered:

1. B.S. or B.A., generally after four years of undergraduate study.
2. Ph.D., generally after four years of study and research beyond the bachelor's level.

The following courses are offered in conjunction with the above programs:

UNDERGRADUATE

Bio 36a	Ecology
Bio 36b	Evolutionary Biology
Bio 37b	Biological Resources of the Sea
Bio 41a	The Invertebrates
Bio 48b	Tropical Marine Ecology
G&G 12a	Oceans
GUG 17b	Long Island Sound: Science and Use
G&G 32a	Chemistry of Natural Waters
G&G 35a	Introduction to Physical Oceanography
G&G 42b	Marine Paleoecology and Environmental Reconstruction

GRADUATE

Bio 336a	Ecology
Bio 341b	Comparative Morphology and Phylogeny of the Invertebrates
Bio 348b	Tropical Marine Biology
Bio 383a, b	Seminar in Paleobiology of the Mollusca
Bio 384a	Paleobiology of Fishes
G&G 211b	Marine Paleoecology and Environmental Reconstruction
G&G 120a	Physics of the Earth's Surface
G&G 233a	Geophysical Fluid Dynamics
G&G 234a	Advanced Physical Oceanography
G&G 337b	Oceanographic Measurements and Observations
G&G 243b	Physical Chemistry of Sedimentary Processes
G&G 240b	Marine and Surficial Geochemistry

The instructional staff for the courses listed above includes the following:

BIOLOGY

Hartman, W. D., Ph. D., Associate Professor
Merriman, D., Ph. D., Associate Professor
Ramus, J. S., Ph. D., Assistant Professor
Thomson, K. S., Ph. D., Associate Professor
Trench, R., Ph. D., Assistant Professor
Waterman, T. H., Ph. D., Professor

GEOLOGY AND GEOPHYSICS

Berner, R. A., Ph. D., Professor
Gordon, R. B., D. Eng., Professor
Rhoads, D. C., Ph. S., Associate Professor
Rossby, H. T., Ph. D., Assistant Professor
Turekian, K. K., Ph. D., Professor
Veronis, G., Ph. D., Professor

To obtain further information, address all inquiries directly to the Director of Graduate Studies in the department of interest.

The following is a list of colleges and universities appearing in the previous edition but which for one reason or another are not listed in this volume.

As a number of the institutions here listed are known to have active marine science programs, students and others interested may want to contact those nearby to determine the current status.

Reasons for non-inclusion in this volume include: no response or a late response to the questionnaire circulated, presence of a smaller program (less than 25 hours) than needed for inclusion or the dropping of marine science activities from the curricula. Also, reorganization of some state systems affected school listings.

CALIFORNIA

California Institute of Technology, Pasadena
California State College, Long Beach
Chapman College, Orange
College of Marin, Kentfield
Sacramento State College, Sacramento
San Diego State College, San Diego

CONNECTICUT

University of Bridgeport, Bridgeport

DISTRICT OF COLUMBIA

U. S. Department of Agriculture Graduate School

FLORIDA

Florida Atlantic University, Boca Raton
Nova University, Fort Lauderdale

HAWAII

University of Hawaii, Honolulu

MAINE

The Research Institute of the Gulf of Maine, Portland

MASSACHUSETTS

Bridgewater State College, Bridgewater
Clark University, Worcester
University of Massachusetts, Amherst
Northeastern University, Boston
Salem State College, Salem

NEW JERSEY

New Jersey Marine Sciences Consortium, Marmore

NEW YORK

Fordham University, Bronx
New York University, New York

PENNSYLVANIA

University of Pennsylvania, Philadelphia

PUERTO RICO

University of Puerto Rico, Mayaguez

TEXAS

Gulf University Research Corporation, College Station
Texas Maritime Academy, Galveston

WASHINGTON

Western Washington State College, Bellingham