CATALOG

1985-86

THE COLLEGE OF WILLIAM & MARY
SCHOOL OF MARINE SCIENCE
August, 1985

NOTE: This catalog provides announcements for the 1985-1986 academic year. It is current until August, 1986. The College reserves the right to make changes in the regulations, charges, and curricula listed herein at any time.

Catalogs are issued for College programs as follows:

- Undergraduate
- School of Business Administration
- School of Education
- Graduate Studies in Arts and Sciences
- School of Marine Science
- Marshall-Wythe School of Law
- Summer Sessions
- Special Programs
1985-86

CATALOG

THE COLLEGE OF WILLIAM & MARY

SCHOOL OF MARINE SCIENCE

Virginia Institute of Marine Science

Gloucester Point, Virginia 23062
SCHOOL OF MARINE SCIENCE
1985-86 PROGRAM

TABLE OF CONTENTS

School of Marine Science Calendar ........................................ 2
Board of Visitors ............................................................. 3
Officers of Administration ................................................... 3
The Faculty of the School of Marine Science ............................ 4
Associate Faculty .............................................................. 9
General Statement of Policy .................................................. 11
The College of William and Mary .......................................... 12
School of Marine Science ..................................................... 14
Program ............................................................................. 16
Preparatory Studies .......................................................... 17
Description of Courses ......................................................... 18
Degree Requirements .......................................................... 29
    General ....................................................................... 29
    Degree of Master of Arts ............................................... 30
    Degree of Doctor of Philosophy ....................................... 31
Financial Information .......................................................... 32
    Tuition and Fees .......................................................... 32
    Eligibility for In-State Tuition Rate .................................. 33
    Payment of Accounts ..................................................... 33
    Refunds ....................................................................... 33
    Credit on Accounts ....................................................... 34
    Withholding of Transcripts and Diplomas ............................ 34
Admissions ........................................................................... 35
    Application ..................................................................... 35
    Foreign-Educated Students .............................................. 35
    Admission ..................................................................... 35
General Information ............................................................. 36
    Financial Aid ................................................................. 36
    Virginia War Orphans Education Program .......................... 37
    Transfer of Graduate Credit ............................................ 37
    Changes in Registration .................................................. 37
Examinations ......................................................................... 38
    The Honor System ........................................................ 38
    Sexual Harassment ......................................................... 38
Submission of Theses and Dissertations .................................. 39
Notice of Candidacy for Graduation ....................................... 39
Grading System ..................................................................... 39
The College of William and Mary

SCHOOL OF MARINE SCIENCE

Calendar 1985-86

1985

FIRST SEMESTER

Registration of Graduate Students
August 21  A - H (Names starting with)  (Wednesday)
August 22  I - P (Names starting with)  (Thursday)
August 23  Q - Z (Names starting with)  (Friday)
August 26-27  New Student Orientation (Monday-Tuesday)
August 29  Beginning of Classes: 8 a.m. (Thursday)
September 13  Last day to add courses (Friday)
October 14-15  Fall Break (Monday-Tuesday)
October 18  Mid-Semester
November 27  Beginning of Thanksgiving Holiday:
              1 p.m. (Wednesday)
December 2  End of Thanksgiving Holiday:
            8 a.m. (Monday)
December 6  End of Classes: 5 p.m. (Friday)
December 7-10  Reading Period (Saturday-Tuesday)
December 11-19  Examinations (Wednesday-Thursday)
December 18  Last date to submit theses and dissertations for
              December conferral of degrees (Wednesday)

1986

SECOND SEMESTER

Registration of Graduate Students
January 6  A - H (Names starting with)  (Monday)
January 7  I - P (Names starting with)  (Tuesday)
January 8  Q - Z (Names starting with)  (Wednesday)
January 9  New Student Orientation (Thursday)
January 13  Beginning of Classes: 8 a.m. (Monday)
January 27  Last day to add courses (Monday)
February 8  Charter Day (Saturday)
February 28  Beginning of Spring Vacation:
              5 p.m. (Friday)
March 10  End of Spring Vacation:
          8 a.m. (Monday)
March 10  Mid-Semester
April 23  End of Classes: 5 p.m. (Wednesday)
April 24-27  Reading Period (Thursday-Sunday)
April 28-May 6  Examinations (Monday-Tuesday)
May 5  Last day to submit theses and dissertations
       for May Commencement (Monday)
May 11  Commencement (Sunday)
SUMMER SESSION

May 9-10  Registration of Graduate Students
June 2    Beginning of First Term (Monday)
July 4    End of First Term (Friday)
July 7    Beginning of Second Term (Monday)
August 8  End of Second Term (Friday)
August 8  Last day to submit theses and dissertations for
           August conferral of degrees (Friday)

BOARD OF VISITORS

Anne Dobie Peebles '44 ........................................... Rector
Hays T. Watkins LL.D. '82........................................... Vice Rector
Henry T. Tucker, Jr. '72 ........................................... Secretary

Sharon A. Coles '75
The Honorable Richard J. Davis '42
Caroline T. Egelhoff '46
Robert J. Faulconer '43
Stewart H. Gamage '72
Lewis L. Glucksman '45
The Honorable A. Linwood Holton LL.D. '72

Jeanne S. Kinnamon '39
Joseph R. Koons '68
James W. McGlothlin '62
A. Addison Roberts '35
Harriet N. Storm '64
John H. Tucker, Jr. '54
James E. Ukrop '60

OFFICERS OF ADMINISTRATION

Paul R. Verkuil ....................................................... President
George R. Healy ..................................................... Provost
Duane A. Dittman ................................................... Vice President for
           University Advancement
Lawrence W. Broomall, Jr. .......................... Vice President for
           Business Affairs
Frank O. Perkins .................................................. Dean, School of
           Marine Science
John M. Zeigler ..................................................... Associate Dean,
           School of Marine Science
Paul V. Koehly ...................................................... Associate Director
           for Finance and Administration,
           School of Marine Science
THE FACULTY OF THE SCHOOL OF MARINE SCIENCE

Frank O. Perkins, Dean and Professor of Marine Science. B.A., University of Virginia; M.S., Ph.D., Florida State University.

John M. Zeigler, Associate Dean and Professor of Marine Science. B.A., University of Colorado at Boulder; Ph.D., Harvard University.

Jay D. Andrews, Professor Emeritus of Marine Science. B.S., Kansas State College; M.A., Ph.D., University of Wisconsin.

Michael E. Bender, Professor of Marine Science. B.A., Southern Illinois University; M.S., Michigan State University; Ph.D., Rutgers University.

Rudolf H. Bieri, Professor of Marine Science. Dr.rer.nat. Johann Gutenberg University.

Robert J. Byrne, Professor of Marine Science. M.S., Ph.D., University of Chicago.

Mark E. Chittenden, Jr., Professor of Marine Science. B.A., Hobart College; M.S., Ph.D., Rutgers University.

William D. DuPaul, Professor of Marine Science. B.S., Bridgewater State College; M.A., Ph.D., College of William and Mary.

George C. Grant, Professor of Marine Science. B.S., University of Massachusetts; M.A., College of William and Mary; Ph.D., University of Rhode Island.

William J. Hargis, Jr., Professor of Marine Science. A.B., M.A., University of Richmond; Ph.D., Florida State University.

Dexter S. Haven, Professor Emeritus of Marine Science. B.S., M.S., Rhode Island State College.

Albert Y. Kuo, Professor of Marine Science. B.S., National Taiwan University; M.S., University of Iowa; Ph.D., The Johns Hopkins University.

Joseph G. Loesch, Professor of Marine Science. B.S., University of Rhode Island; M.S., Ph.D., University of Connecticut.

Maurice P. Lynch, Professor of Marine Science. A.B., Harvard University; M.A., Ph.D., College of William and Mary.

John A. Musick, Professor of Marine Science. A.B., Rutgers University; M.A., Ph.D., Harvard University.

Maynard M. Nichols, Professor of Marine Science. B.S., Columbia University; M.S., Scripps Institution of Oceanography; Ph.D., University of California at Los Angeles.
N. Bartlett Theberge, Jr., Professor of Marine Science. B.S., J.D., College of William and Mary; LL.M., University of Miami.

Willard A. Van Engel, Professor Emeritus of Marine Science. Ph.B., Ph.M., University of Wisconsin.

Marvin L. Wass, Professor Emeritus of Marine Science. B.S., Winona State College; M.S., Florida State University; Ph.D., University of Florida.

Kenneth L. Webb, Professor of Marine Science. A.B., Antioch College; M.S., Ph.D., Ohio State University.

L. Donelson Wright, Professor of Marine Science. B.A., University of Miami; M.A., University of Sydney; Ph.D., Louisiana State University.

Herbert M. Austin, Associate Professor of Marine Science. B.S., Grove City College; M.S., University of Puerto Rico; Ph.D., Florida State University.

John D. Boon, III, Associate Professor of Marine Science. B.A., Rice University; M.A., Ph.D., College of William and Mary.

Eugene M. Burreson, Associate Professor of Marine Science. B.S., Eastern Oregon College; M.S., Ph.D., Oregon State University.

Michael Castagna, Associate Professor of Marine Science. B.S., M.S., Florida State University.

Robert J. Diaz, Associate Professor of Marine Science. B.A., LaSalle College; M.S., Ph.D., University of Virginia.

David A. Evans, Associate Professor of Marine Science. B.A., M.A., Cambridge University; Ph.D., Oxford University.

Leonard W. Haas, Associate Professor of Marine Science. A.B., Dartmouth College; M.S., University of Rhode Island; Ph.D., College of William and Mary.

Robert J. Huggett, Associate Professor of Marine Science. M.S., Scripps Institution of Oceanography; Ph.D., College of William and Mary.

Howard I. Kator, Associate Professor of Marine Science. B.S., Harpur College; Ph.D., Florida State University.

William G. MacIntyre, Associate Professor of Marine Science. B.S., M.S., Ph.D., Dalhousie University.

Rogert L. Mann, Associate Professor of Marine Science. B.S., University of East Anglia; Ph.D., University of Wales.

Bruce J. Neilson, Associate Professor of Marine Science. B.A., M.S.E., M.A., Princeton University; Ph.D., The Johns Hopkins University.
Robert J. Orth, Associate Professor of Marine Science. B.S., Rutgers University; M.A., University of Virginia; Ph.D., University of Maryland.

Polly A. Penhale, Associate Professor of Marine Science. B.A., Earlham College; M.S., Ph.D., North Carolina State University.

Morris H. Roberts, Jr., Associate Professor of Marine Science. B.A., Kenyon College; M.A., Ph.D., College of William and Mary.

Evon P. Ruzek, Associate Professor of Marine Science. A.B., Knox College; M.S., University of Wisconsin; Ph.D., University of Virginia.

Gene M. Silberhorn, Associate Professor of Marine Science. B.S., Eastern Michigan University; M.S., West Virginia University; Ph.D., Kent State University.

Craig L. Smith, Associate Professor of Marine Science. A.B., The Johns Hopkins University; Ph.D., University of Florida.

Beverly A. Weeks, Associate Professor of Marine Science. B.A., Winthrop College; M.S., Tulane University; Ph.D., North Carolina State University.

Richard L. Wetzel, Associate Professor of Marine Science. B.S., M.S., University of West Florida; Ph.D., University of Georgia.

John M. Brubaker, Assistant Professor of Marine Science. A.B., Miami University; Ph.D., Oregon State University.

Carl F. Cerco, Assistant Professor of Marine Science. B.S., Newark College; M.S., University of North Carolina and Massachusetts Institute of Technology; Ph.D., College of William and Mary.

Fu Lin Chu, Assistant Professor of Marine Science. B.S., Chung Chi College; M.S., University of Rochester; Ph.D., College of William and Mary.

Ashok D. Deshpande, Assistant Professor of Marine Science. B.S., M.S., University of Poona; Ph.D., National Chemical Laboratory.

Lehman L. Ellis, Assistant Professor of Marine Science. B.S., University of Texas at Arlington; Ph.D., University of South Carolina.

Mary C. Gibbons, Assistant Professor of Marine Science. B.A., M.S. University of Delaware; Ph.D., State University of New York at Stonybrook.

John Greaves, Assistant Professor of Marine Science. B.Sc., Leeds University; Ph.D., Liverpool University.

Carl H. Hershner, Assistant Professor of Marine Science. B.S., Bucknell University; Ph.D., University of Virginia.
Carl H. Hobbs, III, Assistant Professor of Marine Science. B.S., Union College; M.S., University of Massachusetts.

Paul V. Hyer, Assistant Professor of Marine Science. B.S., University of Notre Dame; Ph.D., University of Maryland.

Brenda L. Norcross, Assistant Professor of Marine Science. A.B., MacMurray College; M.S., St. Louis University; Ph.D., College of William and Mary.

John E. Olney, Assistant Professor of Marine Science. B.S., M.A., College of William and Mary.

Nungjane C. Shi, Assistant Professor of Marine Science. B.S., National Taiwan University; M.S., Ph.D., University of Washington.

J. Ernest Warinner, III, Assistant Professor of Marine Science. B.S., M.A., College of William and Mary.

Frank J. Wojcik, Assistant Professor of Marine Science. B.S., University of Massachusetts; M.S., University of Alaska.

David E. Zwerner, Assistant Professor of Marine Science. B.S., George Washington University; M.A., College of William and Mary.

Gary F. Anderson, Instructor in Marine Science. B.S., Southampton College; M.A., College of William and Mary.

Thomas A. Barnard, Jr., Instructor in Marine Science. B.A., Milligan College; M.A., College of William and Mary.

Paul O. deFur, Jr., Instructor in Marine Science. B.S., University of North Carolina; M.S., University of Michigan Ann Arbor.

Kevin P. Kiley, Instructor in Marine Science. B.S., Tufts University; M.A. College of William and Mary.

Jon A. Lucy, Instructor in Marine Science. B.S., University of Richmond; M.A., College of William and Mary.

Mark W. Luckenbach, Instructor in Marine Science. B.S., University of North Carolina; Ph.D., University of South Carolina.

Robert J. Lukens, Instructor in Marine Science. B.S., Massachusetts Institute of Technology.

Brian W. Meehan, Instructor in Marine Science. B.S., Wagner College; M.S., University of Bridgeport; Ph.D., College of William and Mary.

Kenneth A. Moore, Instructor in Marine Science. B.S., Pennsylvania State University; M.S., University of Virginia.
Walter I. Priest, III, Instructor in Marine Science. B.S., Virginia Military Institute; M.S., Old Dominion University.

Martha W. Rhodes, Instructor in Marine Science. B.S., Virginia Polytechnic Institute and State University; M.A., Medical College of Virginia, Virginia Commonwealth University.

Michael E. Sieracki, Instructor in Marine Science. B.A., University of Delaware; M.S., Ph.D., University of Rhode Island.

Jacques van Montfrans, Instructor in Marine Science. B.S., Florida State University; M.S., Florida Atlantic University.

Susan O. Barrick, Librarian. B.S., Shepherd College; M.L.S., Case Western Reserve.
ASSOCIATE FACULTY

Gary L. Anderson, B.S., Gustavus Adolphus College; M.S., University of Puerto Rico.

Roger D. Anderson, B.A., St. Olaf College; M.S., Ph.D., Texas A&M University.

Robert E. Lee Black, A.B., William Jewell College; M.A., Ph.D., University of Washington.

Donald F. Boesch, B.S., Tulane University; Ph.D., College of William and Mary.

Mitchell A. Byrd, B.S., M.S., Ph.D., Virginia Polytechnic Institute and State University.

H. Jacques Carter, B.S., M.S., Northern Illinois University; Ph.D., College of William and Mary.

Ching Seng Fang, B.S., National Taiwan University; M.S., Ph.D., North Carolina State University.

Franklin H. Farmer, B.S., Tufts University; M.S., Ph.D., Virginia Polytechnic Institute and State University.

Michael L. Fine, B.S., University of Maryland; M.A., College of William and Mary; Ph.D., University of Rhode Island.

John J. Govoni, A.B., St. Anselm's College; M.S., Southeastern Massachusetts University; Ph.D., College of William and Mary.

Robert C. Harriss, B.S., Florida State University; M.A., Ph.D., Rice University.

Harold J. Humm, B.S., University of Miami; M.S., Ph.D., Duke University.

Gerald H. Johnson, B.S., M.A., Ph.D., Indiana University.

James A. Lanier, B.A., University of Virginia; M.S., Ph.D., College of William and Mary.

Martin L. Lenhardt, B.S., M.A., Seton Hall University; Ph.D., Florida State University.

Victor A. Liguori, A.B., Haverford College; M.A., Ph.D., Princeton University.

Charlotte P. Mangum, A.B., Vassar College; M.S., Ph.D., Yale University.
James G. Mead, B.S., Yale University; M.A., University of Texas; Ph.D., University of Chicago.

John V. Merriner, B.A., Rutgers University; M.S., Ph.D., North Carolina State University.

John C. Munday, Jr., A.B., Cornell University; Ph.D., University of Illinois.

Thomas H. Probert, B.A., University of New Hampshire; ABT, Northeastern University; M.S., Ph.D., University of Massachusetts.

Carl N. Shuster, Jr., B.S., M.S., Rutgers, The State University of New Jersey; Ph.D., New York University.

Kenneth J. Sulak, B.A., Harvard University; M.S., University of Miami.

Lamar Trott, A.A., St. Petersburg Junior College; B.A., M.A., Florida State University; Ph.D., University of California.

Sheppard Y. Tyree, Jr., B.S., Ph.D., Massachusetts Institute of Technology.

James E. Weaver, B.S., M.S., Louisiana State University; Ph.D., University of Virginia.

Michael P. Weinstein, B.A., Hofstra University; M.S., Rutgers State University; Ph.D., Florida State University.

Christopher S. Welch, B.S., Stanford University; Ph.D., Massachusetts Institute of Technology.

Scott C. Whitney, A.B., University of Nevada; LL.B., J.D., Harvard Law School.

Lawrence L. Wiseman, A.B., Hiram College; M.A., Ph.D., Princeton University.

Paul L. Zubkoff, B.S., University of Buffalo; M.A., George Washington University; Ph.D., Cornell University.
GENERAL STATEMENT OF POLICY

Within the limits of its facilities and its obligations as a state university, The College of William and Mary opens the possibility of admission to all qualified students without regard to sex, race, color, age, religion, or national origin, and provides reasonable accommodation for handicapped students. The facilities and services of the College are open to all enrolled students on the same basis, and all standards and policies of the institution, including those governing employment, are applied accordingly.

Senior citizens of Virginia who wish to take advantage of fee waiver privileges in order to attend courses at William and Mary are invited to contact the Office of Admissions for full details.

The College reserves the right to make changes in the regulations, charges, and curricula listed herein at any time.
OBJECTIVES OF THE COLLEGE

Founded in 1693 as the second institution of higher education in the country, The College of William and Mary in Virginia is today a small, residential, full-time, coeducational university. It is a state university, drawing seventy percent of its 4,700 undergraduate students from the Commonwealth of Virginia. It is also national and international in character and contribution, enrolling students with varied backgrounds from throughout the nation and from many foreign countries.

William and Mary at the undergraduate level is dedicated to providing a liberal education that is rounded and thorough. All students gain a broad base of understanding and knowledge in arts and sciences in their freshman and sophomore years. In their junior and senior years, they may pursue work toward the Bachelor of Arts or Bachelor of Science degrees in a full range of concentrations in arts and sciences or education, or they may enter a program of study in the School of Business Administration leading to the Bachelor of Business Administration degree.

The College also provides the opportunity for its students to pursue graduate work compatible with the liberal undergraduate program. Several departments in the School of Arts and Sciences offer advanced studies leading to the Master of Arts or Master of Science degrees. The History, Physics, and Psychology departments have programs leading to the Ph.D. and Psy.D. degrees. In the professional schools, the Marshall-Wythe School of Law offers the Juris Doctor degree; the School of Business Administration offers the M.B.A.; and the School of Education offers the Master of Arts in Education, the Certificate of Advanced Study, and the Doctor of Education. The School of Marine Science offers programs leading to M.A. and Ph.D. degrees.

The College's commitment in all programs to liberal education is the source of institutional coherence. William and Mary emphasizes, in its undergraduate, graduate and professional programs, the development of the student as a whole individual. The criterion of excellence in teaching and learning, in class and out of class, is at the heart of the educational process. With such objectives, and with a selective and limited enrollment, the College strives to provide its students with a high quality education, and to make a significant contribution to the Commonwealth of Virginia and to the nation through the development of independent, responsive individuals. Faculty, students, and administrators work closely together to create this educational environment, under the leadership of the Board of Visitors and with the support of the Board of the Society of the Alumni.

Continuing exploration of and participation in innovative and experimental approaches to teaching and learning are a significant aspect of the College's forward movement, and emphasis on research and high quality graduate programs contribute strongly to the development of excellence at William and Mary.

The College is accredited by the Southern Association of Colleges and Schools. It offers a wide range of courses, seminars, and programs both for credit and non-credit, in the evening and during the day, at its Williamsburg campus and at the Gloucester Point and Wachapreague campuses of
the School of Marine Science. This contribution to the educational enrichment of the citizens of Virginia throughout their careers is provided by the professional schools of education, business, and law, and by the faculty of arts and sciences. It is in keeping with the College's commitment as a state institution to community service and enhanced educational opportunities for the adult citizens of the Commonwealth, and for its more than 30,000 alumni.

William and Mary is a college community, small enough to provide for relationships that allow true teaching and learning, large enough to have the resources to achieve excellence. An important aspect of this community is the location of the College in the beautiful and historic city of Williamsburg, where it constitutes an integral part of the restoration of Colonial Williamsburg. The partnership of the College, the City, the Restoration, and the educational, cultural and recreational opportunities afforded to all students at the College by this partnership add to the quality of life and the quality of education at William and Mary.
SCHOOL OF MARINE SCIENCE

VIRGINIA INSTITUTE OF MARINE SCIENCE

History

The School of Marine Science had its inception in the establishment of the Virginia Fisheries Laboratory by the Commonwealth in 1940. From 1940 until 1959 the academic program of the Laboratory was conducted by the Department of Biology of The College of William and Mary.

In 1959 the program became the Department of Marine Science, and in 1961 the Board of Visitors established the marine training program as the School of Marine Science. The General Assembly in 1962 reestablished the Virginia Fisheries Laboratory as the Virginia Institute of Marine Science, an independent research and service institution providing educational offerings in the marine sciences. In 1979 the General Assembly merged the Institute with The College of William and Mary.

Laboratories of the Institute originally were on the main campus at Williamsburg and at Yorktown. In 1950 the first permanent building was erected on the present campus at Gloucester Point, across the York River from Yorktown. The School awarded its first master's degree in 1943, and in 1964 inaugurated a doctoral program in Marine Science.

Facilities

Students of marine science (including marine fisheries science, biological, chemical, geological, and physical oceanography, and certain other areas of concentration including marine resource management), through offerings of the School of Marine Science, have the unusual opportunity to participate in advanced undergraduate and graduate education at an active, year-round center of marine research.

The principal marine campus is located at Gloucester Point on the York River, an important estuary with easy access to the Chesapeake Bay and the nearby Atlantic. The Institute and the School are admirably situated for performing research and teaching marine, estuarine, and freshwater biology, chemistry, geology, physical oceanography, and marine engineering. The campus of the Eastern Shore Branch Laboratory at Wachapreague, Virginia, offers access to the embayments, salt marshes, barrier beaches, and coastal waters of Virginia's Eastern Shore. The Wachapreague facility has laboratories for mariculture and research as well as dormitory and classroom space.

The first permanent building, Maury Hall, constructed in 1950, is devoted primarily to laboratories. Brooke Hall (1958) contains offices and other laboratory facilities, and Davis Hall (1961) houses the scanning and transmission electron microscopes. The second floor of Davis Hall (added in 1974) houses laboratories associated with the microbiology program. Byrd Hall (1969) houses ecology-pollution, chemistry, physiology, and laboratories. Jefferson Hall (which was purchased in 1966 and enlarged in 1972) houses most of the faculty and staff of marine fisheries science and
laboratories as well as the vertebrate and invertebrate collections of the Institute. Six buildings have flow-through saltwater systems providing additional experimental facilities. Modern, well-equipped chemical laboratories allow scientists and students to pursue marine chemistry with state-of-the-art facilities. The small-boat basin and Newport Building are located at the Franklin Marine Center. The Division of Physical Sciences and Ocean Engineering is quartered in several buildings about the campus as well as at the Franklin Marine Center. Geological Oceanography is centered in the Hoxton Building and has facilities in several adjacent buildings. Watermen’s Hall, completed in 1984, contains three fully equipped teaching laboratories, three classrooms, a marine science library containing approximately 34,000 volumes and 1500 serial titles, a time-sharing Prime 850 computer, as well as central administration, advisory services, and a 273-seat auditorium.

The Institute has an extensive complement of modern scientific equipment including a mass spectrometer, two electron microscopes (both scanning and transmission) and a side scan sonar system. A hydraulic flume is housed in the Franklin Marine Center.
PROGRAM

The program of the School of Marine Science is intended primarily for the student who wishes to specialize in marine science at the graduate level. The degrees offered are the Master of Arts and Doctor of Philosophy in Marine Science. Majors in biological, physical, chemical or geological oceanography, marine fisheries science, and marine resource management are available. Within these general areas, there are several specialties which may be studied—such as: marine pollution biology, wetlands ecology, benthic ecology, and coastal processes. The curriculum available to students working toward either degree is comprised of some 68 formal courses, 2 problems courses, 2 seminar courses, and 2 theses courses.

Students who wish to enter into the doctoral program must hold a master's degree from an accredited institution; however, it is possible for students in residence to by-pass the master's degree with the approvals of the Academic Status and Degrees Committee and the Dean.

Though the courses offered by the School are primarily for graduate students, advanced undergraduates (juniors and seniors) may participate. For instance, biology, chemistry, and geology majors may enroll in suitable 500 level courses. Undergraduates majoring in chemistry, geology, physics, or physiology may work on problems in their fields of specialization. Consent of the Chairman of the student's major department is required for an undergraduate student to take problems courses in marine science.

As in most marine institutions, activities accelerate during the summer. Qualified undergraduate students may take advanced courses in invertebrate ecology, marine fisheries science, physiology, and other subjects as scheduled. In addition to the regular academic courses offered, special summer research courses in marine science may be arranged.

The faculty is heavily engaged in research in addition to teaching. Students have an unusual opportunity to become intimately familiar with their fields of interest. This advantage is increased by the fact that the student's entire program is carried out on the coast. Time is not lost in traveling from an inland campus to the sea; and the sea itself is a constant classroom companion.

Approved marine science courses are offered at Williamsburg, but most are conducted on the campus of the School of Marine Science at Gloucester Point, Virginia. Accordingly, students commuting between campuses must schedule classes so as to allow time between them. Usually, thirty minutes are required to make the passage.
PREPARATORY STUDIES

Students who are seriously interested in marine science as a profession should consult with the Dean of the School as early in their college careers as possible regarding an academic program to be followed.

In general, all science is highly quantitative. Regardless of one’s field of concentration, a solid background in mathematics through differential equations, a year of statistics, physics, and chemistry, and competence with computers is highly recommended. Students interested in biological oceanography or marine fisheries science should take, in addition to the quantitative courses listed above, organic chemistry, biochemistry and a suite of contemporary biology courses.

The prospective chemical, geological, or physical oceanographer should have an undergraduate major in chemistry, physics, meteorology, geology, engineering, or mathematics. It is assumed that any one of these physical science degrees includes the quantitative courses discussed above, but particularly helpful are courses in fluid mechanics, time series analysis, and thermodynamics.
DESCRIPTION OF COURSES

501. Introduction to Physical Oceanography. Fall (3) Mr. Ruzecki. Prerequisites: Undergraduate Physics, Undergraduate Math.

Physical properties of seawater, descriptive oceanography, air-sea interactions, heat budget, methods and measurements, dynamics of circulation, waves and tides. Required of all students unless justification for exemption is approved by the Dean of the School of Marine Science upon the recommendation of the appropriate faculty committee. Lectures and laboratory.

502. Introduction to Chemical Oceanography. Spring (3) Mr. Huggett, Mr. Bieri. Prerequisite: Undergraduate Chemistry.

Major and minor components of seawater, the concept of residence time, solution chemistry of organic compounds, nutrient cycling, dissolved gases, radioactive dating, geochemical cycles, biosynthesis in marine environments, organic geochemistry, anthropogenic input. Laboratory demonstration of analytical methods for organic analysis. Required of all students unless justification for exemption is approved by the Dean of the School of Marine Science upon the recommendation of the appropriate faculty committee.

503. Introduction to Biological Oceanography. Fall (3) Mr. Roberts.

Introduction to principles and concepts of marine ecology; characteristics of the oceans and estuaries as ecosystems. Occurrence and distribution of marine organisms in relation to hydrography. Required of all students unless justification for exemption is approved by the Dean of the School of Marine Science upon the recommendation of the appropriate faculty committee. Lectures and laboratory.

504. Introduction to Geological Oceanography. Spring (3) Mr. Boon, Mr. Hobbs, Mr. Wright.

Concepts of marine geology: coastal processes, sea-floor spreading and plate tectonics, sediments and sedimentation, shelf and canyon development. Required of all students unless exemption is approved by the Dean of the School upon the recommendation of the appropriate faculty committee. Lectures and field trips.

505. Problems in Marine Science. Fall, Spring and Summer (1-4) Staff.

Supervised projects selected to suit the need of the graduate student. This is the avenue through which subjects not covered in other formal courses are offered. Projects are chosen in consultation with the student's supervising professor and the instructor. Credit hours depend upon the difficulty of the project and must be arranged with the instructor in advance of registration. (See MS 603).

506. Introduction to Marine Science. Summer Session (3) Mr. Loesch.

A general introduction to marine science, including biological, chemical, geological, and physical oceanography. Normally taught on the Williamsburg campus. Not open to graduate students in the School of Marine Science.
507. Statistics for Marine Scientists I. Fall (3) Mr. Diaz.
Application of statistical methods to analysis of biological and physical data. Binomial and chi-square distributions, normal distribution. Hypothesis testing, introduction to analysis of variance and regression analysis. Three lecture hours. Required of all students unless justification for exemption is approved by the Dean of the School of Marine Science upon the recommendation of the appropriate faculty committee.

508. Introduction to Computers for Marine Scientists. Fall (1) Staff.
Introduction to the use of a time-sharing computer system in scientific research. Creation and editing of files. Organization of the files on a computer. Introduction to user systems such as statistical (SPSS), spatial analysis (SURFACE II), word-processing (MUSE), graphics (SPSS Graphics and BAYPLOT), data management and retrieval systems (POWER and SIR). The student will gain insight into the ways in which modern computer systems can aid research without the user having programming knowledge.

509. Program Design and Data Structures Using PASCAL. Spring (2) Mr. Lukens.
Structured programming techniques are presented using the PASCAL programming language. Elementary data structures are presented with attention to forms which are useful in scientific programming. Practical applications are stressed with emphasis on graphics in the latter portion of the course. The linkage of system and user-written libraries to PASCAL programs is covered. Class assignments are carried out on the VIMS PRIME 850.

510. Marine and Freshwater Invertebrates. Summer, even-numbered years (4) Staff.
Classification and identification, adaptation, ecology, life histories. Local marine, estuarine and freshwater forms emphasized. Lectures, laboratory and field trips, twenty-six hours per week for five weeks.

512. Marine Botany. Summer, odd-numbered years (4) Staff.
A general introduction to the ecology and systematics of algae and tracheophytes encountered in the marine environment. Lectures, laboratory and field trips, twenty-six hours per week for five weeks.

513. Coastal Botany. Fall (3) Mr. Silberhorn.
A general survey of maritime vascular plant communities. Marshes, swamps, beaches, dunes, maritime forests and submerged aquatic communities of the coastal region. Field trips, laboratory and lectures.

514. Introduction to Immunology of Marine Organisms. Spring (3) Ms. Weeks, Mr. Warinner.
A lecture course dealing with fundamental concepts in immune responses. The development of cellular and humoral immune responses and their regulation are considered in relation to infectious disease, allergy, tissue transplantation, neoplasia, autoimmune disease and immunodeficiency. Also considered are the properties of antigens and immunoglobul-
ins, immunologic specificity and methods for monitoring immune responses. Acquired and innate immunity and the structure and function of the lymphoreticular system of fish will be considered in detail.

516. Mathematical Review for Marine Scientists I. As required (3) Mr. Evans.
A review of mathematical techniques and concepts with which a student in marine science is expected to be familiar. A pragmatic approach to the topics is adopted with examples of applications of mathematical notions whenever possible. Topics to be covered include: elementary algebraic manipulation, linear and quadratic equations, simultaneous equations, trigonometry, analytical geometry, binomial theorem, exponents and logarithms, and elementary differential calculus.

517. Mathematical Review for Marine Scientists II. As required (3) Mr. Evans.
A review of mathematical techniques and concepts with which a student in marine science is expected to be familiar. A pragmatic approach to the topics is adopted with examples of applications of mathematical notions wherever possible. Topics to be covered include: integral calculus, simple differential equations, vectors, matrices (linear algebra).

519. Computer Applications in Marine Science. As required (1) Staff.
Course designed primarily for students who require special programming for analysis of their research data. Following instruction in basics of programming language, each student will develop, with guidance one or more computer programs pertinent to his or her thesis research.

520. Literature Search and Scientific Writing. Spring (1) Mr. Grant, Ms. Barrick.
Instruction in use of selected abstracting and indexing services appropriate to marine science, and development of search strategy techniques applicable to on-line data bases. Step-by-step analysis of the preparation of a journal article; structure and content of research and thesis proposals.

522. Research Budget Planning and Tracking. Fall (2) Mr. Hershner.
The details of calculating line items for proposal budgets, including: mechanics of fringe benefit and indirect cost development; calculation and projection of salaries; computation and identification of matching funds; and preparation of calendar and fiscal year budgets. Course also examines the relationship between institutional and research budgets.

The course is intended for persons concentrating in geological oceanography and offers them experience in field and laboratory techniques which they will need during their careers. Seminars, laboratory, and field exercises.

560. Thesis. Fall, Spring, and Summer (hours to be arranged).
Original research in biological, physical, chemical or geological oceanography, marine fisheries science, and marine resource management. Project
to be chosen in consultation with the student’s major professor and the Dean of the School.

601. Marine Science Seminar. Fall and Spring (1) Staff.
   The organization and presentation of scientific data. Oral discussion and written outlines and critiques of selected seminar topics are required.

602. Advanced Biological Oceanography. As required (3) Staff.
   Lecture and selected seminar topics covering broad concepts, principles and patterns in biological oceanography. Emphasis is on coastal and oceanic ecosystems. Recommended for advanced graduate students.

603. Advanced Problems in Marine Science. Fall, Spring and Summer (1-4) Staff.
   Supervised projects selected to suit the needs of the graduate student. Projects to be chosen in consultation with the student’s major professor and the instructor. Acceptable research outlines and project reports are required. Amount of credit depends upon difficulty of course. Hours to be arranged with instructor prior to registration. The degree of difficulty and requirements of this course surpass those of MS 505.

   An introduction to the history of the management of natural resources and a survey of principles and theories associated with resource management. Although the course addresses general concepts, marine oriented materials and examples will be emphasized.

605. Radiobiology. As required (4) Mr. Warinner.
   The principles of tracer techniques and procedures for radio-assay determinations in marine studies, including autoradiography, liquid scintillation, and gamma ray spectroscopy. Lecture and laboratory.

606. Fisheries Oceanography. Fall (3) Mr. Austin. Prerequisites: Physical Oceanography or Marine Fisheries Science.
   Concept of the effects of natural environmental variability on the recruitment, availability [yield], abundance and behavior of living marine resources. Application to real-time fishing operations and climate scale analysis of fishery fluctuations. Two lecture hours and one laboratory hour.

607. Marine Microbiology. Spring, even-numbered years (4) Mr. Kator, Staff. Prerequisite: Biology 301 or equivalent.
   Morphology, physiology, ecology, taxonomy, and methods of isolation, cultivation and identification of micro-organisms encountered in the marine environment. Three lecture and four laboratory hours.

608. Ichthyology. As required (3 or 5) Mr. Musick.
   Functional morphology, behavior, ecology, zoogeography and evolution of fishes. Seven lecture, laboratory and field hours. Three (3) credits without laboratory; five (5) credits with laboratory.

609. Oceanographic Instrumentation. As required (1) Mr. Ruzecki.
   General description and function of field sensors, instrument suites and
sampling equipment used to study the marine environment to include meteorological, hydrographic, geological, geophysical, chemical and biological measurements. Deployment, retrieval, general maintenance and cost of equipment is stressed. Lecture and demonstration.

610. Pollution Biology. As required (3) Mr. Bender.
   Study of the various types of pollutants, domestic and industrial wastes, soils, insecticides and radioactive materials and their effects on the marine environment.

611. Advanced Analytical Methods for Water Quality Studies. Summer (1) Mr. Neilson, Staff.
   Analytical methods used in assessing water quality conditions in the estuarine and marine environment will be presented. Techniques presented will include basic and specialized physical, chemical, geological, and bacteriological measurements. Related topics, such as NPDES regulations, standardization of procedures and analytical quality control, will be discussed. Three laboratory hours.

612. Diseases of Marine Organisms. Fall, odd-numbered years (4) Mr. Burreson, Staff.
   Identification, life cycles, pathology and control of disease agents, including viruses, bacteria, protozoa, helminths and arthropods in marine fishes and shellfishes. Three lecture and two laboratory hours.

614. Coastal Processes. As required (3) Mr. Nichols. Prerequisites: Marine Science 501 and 504 or consent of instructor.
   Sedimentary processes of erosion, transportation and deposition in response to energy by currents, waves, organisms and man. Character of sedimentary features in a range of environments: estuaries, lagoons, marshes, tidal flats and the continental shelf. Readings of classics, field trips and seminars with discussion of recent advances and controversial questions.

615. Coastal and Estuarine Morphodynamics. Alternate years (3) Mr. Wright. Prerequisites: Marine Science 501 and 504.
   Dynamics of process-form interaction, co-adjustment and morphological changes. Principles of coastal hydrodynamics, sediment transport and morphodynamic adjustment are illustrated with application to continental shelves, nearshore and beach systems, dunes and beach ridges, estuaries and tidal flats, marshes and swamps. Lecture, reading, discussion, and field trips.

616. Depositional Environments and Stratigraphic Models. As required (3) or (4) with laboratory. Staff. Prerequisite: Marine Science 614 or 615.
   Modern and Quaternary depositional products of shelf, coastal and estuarine waters and their relationships to contrasting environments and subenvironments. Primary sedimentary structures and the processes which form them will be considered together with other environmentally diagnostic features such as grain-size distributions, grain shapes, and benthic fauna. Stratigraphic models of shelves, barrier complexes, deltas, bays, and estuaries will be compared. Lecture, reading, and discussion. An optional laboratory may be taken for one (1) extra credit.
617. Biology of Estuarine Fishes. Spring (3) Staff. Prerequisite: Marine Science 608.
Life history, ecology and zoogeography of typical fish taxa inhabiting estuaries along the Atlantic seaboard. Emphasis on behavioral and morphological adaptations in response both to contemporary ecology and the evolutionary history of individual species. Research project on a selected species required. Enrollment limited. Three lecture hours and field trips.

618. Marine Fisheries Science. As required (4) Mr. Austin.
Principles and techniques, including the theory of fishing, age and growth, definition of stocks, catch statistics, description of world fisheries, goals and problems in managing a common property resource. Six lecture, laboratory and field hours.

619. Statistics for Marine Scientists II. Spring (3) Mr. Loesch. Prerequisite: Marine Science 507 or equivalent.
Concepts and methods of experimental statistics, including advanced analysis of variance designs, regression, analysis of covariance, and factorial arrangements. Lecture and laboratory required of all students in Marine Fisheries Science.

620. Organic Geochemistry of the Marine Environment. As required (2) Mr. Bieri, Mr. Kator. Prerequisite: Organic Chemistry.
The course will provide an overview of both non-biogenic and biogenic aspects of diagenetic processes in recent marine sediments. Basic concepts discussed include the importance of physical-chemical conditions, characteristic changes in molecular structure, and the role of microorganisms in the diagenetic process.

Physical chemistry of electrolytic solutions. Study of equilibrium and non-equilibrium models of chemical processes occurring at water-sediment, water-organism, and water-atmosphere boundaries.

622. Mass Spectrometry of Organic Molecules I. Fall (2) Mr. Bieri. Prerequisite: Consent of instructor.
Ionization of atoms and molecules, the deflection of charged particles by electric and magnetic fields. Discussion of different methods of mass to charge separation. Description of several types of mass spectrometers and special requirements for GS-MS systems. Other subjects including vacuum techniques and detection methods.

623. Mass Spectrometry of Organic Molecules II. Spring (1) Mr. Bieri. Prerequisite: Marine Science 622 or consent of instructor.
Interpretive aspects of mass spectra. General discussion of fragmentation. Systematic trends linked to molecular structure will be treated and explained through the use of key examples. Active participation of the student is expected.

Class review and analysis of case studies involving the management of marine resources including socio-economic, political, and legal aspects.
625. Hydromechanics. Fall (3) Mr. Hyer, Mr. Cerco. Prerequisites: Math 302, Physics 102 or equivalent.

Basic principles and equations, flow patterns, energy and momentum principles, dimensional analysis and dynamical similitude, potential flow, viscous flow, turbulence. Gradually varied flow, rapidly varied flow, introduction to coastal hydraulics.

626. Finite-Difference Methods in Fluid Mechanics. As required (3) Mr. Cerco. Prerequisites: Marine Science 516 or equivalent, Marine Science 625 or equivalent, programming ability in FORTRAN, PASCAL or similar language.

An examination of the numerical solution of partial differential equations governing the conservation of mass and of momentum. Topics include spatial differencing, explicit and implicit time differencing, numerical viscosity and dispersion, stability and convergence.

627. Advanced Physical Oceanography. As required (3) Mr. Brubaker. Prerequisite: Marine Science 625 or consent of instructor.

Elements of the dynamics of natural waters, beginning with an overview of the general governing equations and some useful approximations. Effects of variable density, Earth's rotation, and wind forcing, in various combinations, will be examined. The focus will be on settings where bottom topography and the presence of lateral boundaries influence the dynamics, as in continental shelf waters and inland seas.

628. Biological Oceanographic Processes. Spring (3) Staff.

Lecture and discussion of contemporary concepts in oceanographic processes emphasizing microbial-plankton interactions, zooplankton, benthic processes, population dynamics, nutrient cycling and systems, and simulation modeling. Required of all students in Biological Oceanography.

629. Introduction to Sediment Transport. Fall (3) Mr. Byrne, Mr. Boon. Prerequisite: Marine Science 631 or consent of instructor.

Classical and recent work on sediment transport due to unidirectional and wave-induced motion in fluids. Topics include particle settling velocity, incipient motion criteria, bedload and suspended load transport formulations and bedform regimes. Two lecture hours.

630. The Early Life History of Marine Fishes. As required (3) Mr. Olney.

Development, physiology, behavior, and ecology of egg, larval and juvenile stages with special reference to adaptations for larval survival in the sea. Egg and larval taxonomy, techniques in rearing, and egg and larval sampling methods will be outlined. Two lecture and two laboratory hours.

631. Estuarine Dydrodynamics I. As required (3) Mr. Kuo, Mr. Hyer. Prerequisite: Marine Science 625.

Classification of estuaries, time scales of motions, tidal dynamics in estuaries, non-tidal circulation, mechanism of arrested salt wedge, gravitational circulation, diffusion induced circulation, turbulence in stably stratified flows.
632. Estuarine Hydrodynamics II. As required (3) Mr. Kuo, Mr. Cerco. Prerequisite: Marine Science 631.
   Zero-, one- and two-dimensional descriptions of estuaries, salt intrusion, pollutant flushing, sediment transport through estuaries, field experience in estuaries, model laws for estuarine models.

633. Geostatistics and Time Series Analysis. Spring (2) Mr. Shi, Mr. Boon. Prerequisite: Marine Science 507 or consent of instructor.
   A review of probability and statistical methods designed for geological/geophysical students. Fourier transform theory, spectral analysis of univariate and multivariate time series data and filter design. FORTRAN 77 program applications to demonstrate techniques and the interpretation of results from selected geophysical data sets.

634. Scientific Information Resources. Spring, odd-numbered years (1) Mr. Lynch.
   A review of available data bases, referral systems, federal information programs, etc., which would aid scientists or environmental managers in obtaining information relative to their research or management needs.

636. Ecosystem Model Simulation and Analysis. Fall, As required (3) Mr. Wetzel. Prerequisite: Consent of instructor.
   Theoretical and practical aspects of conceptualizing, simulating and analyzing digital computer models of estuarine and marine ecosystems. Systems theory, control and optimization is presented in terms of ecological processes. Computer modeling project required. Five lecture and laboratory hours.

   Classical and recent work on wetland ecology, primarily in tidal marshes. Emphasis on the analysis of the marsh system at the community level. Introduction and practical experience in common research techniques, including vegetation mapping, sediment coring and faunal sampling methods. Individual research project and/or paper expected. Lectures and field trips.

638. Turbulent Diffusion and Dispersion. As required (3) Mr. Kuo, Mr. Brubaker. Prerequisite: Marine Science 625 (Hydromechanics).
   Principle of mass conservation, gradient transport theories, turbulent transport and concept of eddy diffusivity, mixing-length theory, higher order turbulence models, dispersion in shear flow, in oscillatory flow and in stratified flow, applications of dispersion theories in estuaries and open seas.

   Water quality parameters, application of mass-balance equation, dissolved oxygen modeling, ecosystem modeling, finite difference approximations, finite element techniques, numerical integrations, time scales and spatial dimensions, survey of different types of models.
Principles and practice of stock identification, recruitment, growth, abundance, mortality, and regulation and yield of fisheries stocks. Three lecture hours and one laboratory hour.

641. Waves and Their Analysis. As required (3) Mr. Wright, Mr. Boon, Mr. Shi. Prerequisite: Marine Science 501.
Introduction to linear wave theory and shoaling wave transformations, wave dispersion, radiation stress, refraction, reflection, and topographic trapping. Mechanisms of wave generation in the coastal boundary layer including oscillations at infragravity, tidal, and transtidal frequencies. Time series analysis, interpretation of wave records using harmonic and spectral methods with computer labs on the VIMS PRIME 850 System.

645. Marine Phytoplankton. Spring, even-numbered years (3) Mr. Haas, Staff. Prerequisites: Marine Science 501, 502, 503, and 504.
Contemporary problems in marine phytoplankton investigations. Factors controlling the distribution, abundance, and production of planktonic organisms. Five lecture and laboratory hours.

646. Marine Zooplankton. Spring, odd-numbered years (3) Mr. Grant.
The morphology, adaptations, distribution, taxonomy and ecology of marine zooplankton with attention to interrelationships with the remaining biota. Five lecture and laboratory hours.

647. Marine Benthos. Spring, odd-numbered years (3) Mr. Diaz. Prerequisites: Marine Science 503, 510 or equivalent.
Ecology of marine benthic organisms. Factors affecting distribution, benthic habitats, structure and function of communities, biotic interrelationships and analytical techniques.

649. Marine Science in Public Affairs. As required (2) Mr. Hargis, Staff.
Consideration of the methods by which public policy and programs regarding marine resources and the environment are established and executed and the role of marine science in those activities. The structure, functioning and management of modern marine research and advisory institutions. Interaction between science and technology and public environment and resource management activities. Discussion of the problems and premises of marine science in public affairs. Lecture, discussion and observation.

650. Law and Resource Management, Spring (1-3) Mr. Theberge.
An interdisciplinary course designed to examine the interrelationships between scientific and legal concepts. Issues, legislation, and institutions associated with coastal zone management, outer continental shelf development, fisheries, and other questions related to marine resource management will be examined.

651. Natural History of the Chesapeake Bay - Physical. Spring (3) Mr. Zeigler.
This course is a non-mathematical summary of the Chesapeake Bay. It stresses the origin of the Bay, its features and dynamics of circulation,
sedimentation, stratigraphy and their interrelation with biology and man's use of the system.

652. Practical Application of Marine Resource Management Techniques. Fall and Spring (1 to 4) Staff. Prerequisite: Marine Science 650.

This course is designed to offer students possessing management fundamentals an opportunity to participate in real world management activities under the guidance of involved faculty members and association and consultation with members of various levels of government. Such activities will possibly include but not be limited to issue identification and resolution, committee involvement at local, regional, state, interstate, and federal levels of government, development of management plans, drafting position papers, developing draft legislation and exposure to policy making mechanisms.

Student requirements may vary significantly depending on the management issue(s) addressed. Students will be evaluated on participation, written work (memoranda, position papers, etc) and knowledge gained as evidenced by interaction with staff and by other means. Students may repeat the course provided the instructor determines there is no duplication of material. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignment.

653. Secondary Production of Invertebrates. As required (3) Mr. Diaz.

Principles and theories of secondary production. Physical and biological factors influencing production, role of habitat complexity, implications for community structure, estimation of trophic resources and techniques of measuring secondary production.

654. Oligochaete Biology. As required (2) Mr. Diaz.

Taxonomy of aquatic and marine oligochaetes, life history strategies and ecology, and the role of oligochaetes in benthic communities.


656. Seagrass Ecosystems. As required (1-2) Ms. Penhale, Mr. Wetzel.

A lecture-seminar course covering topics related to seagrass ecosystems. Emphasis on the structure and function of seagrass communities, submerged angiosperm physiology, primary and secondary production, and integration of seagrass communities to the marine environment. Students will be assigned projects to complete. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignments.

657. Light Microscopy for Marine Scientists. As required (2) Mr. Hargis, Staff.

Principles and practice of various techniques of light microscopy in research and teaching in the marine sciences and related scientific fields. Two lectures and laboratory hours. Research project required.
658. **History of Marine Science. As required (3) Mr. Hargis.**

Comprehensive review and evaluation of the major events, personages, and organizations involved in the development of marine science and marine resource management, the acquisition of knowledge of the World Ocean, its coastal waters and tributaries, and the ability to work on and in the sea and make use of its resources and amenities, with consideration of the impacts of the resources and amenities of the ocean on the affairs of men. Lecture, discussions and reading. All students will be required to prepare and submit a suitable course-related term paper.

660. **Dissertation. Fall, Spring and Summer (hours to be arranged).**

Original research in biological, physical, chemical or geological oceanography, marine fisheries science, or marine resource management. Project to be chosen in consultation with the student's major professor and the Dean of the School.
DEGREE REQUIREMENTS

General

Students generally are bound by the requirements stated in the catalog which is in effect when they enter the School. The following are usually the minimum requirements. The separate subfaculties and individual advisory committees may prescribe additional requirements for their students.

To fulfill the full-time academic residency requirement of the School of Marine Science, students must enroll for one of the following:

1. Twelve hours in the Fall semester and twelve hours in the following Spring semester;
2. Twelve hours in the Spring semester and twelve hours in the following Fall semester;
3. Twelve hours in the Spring semester, followed by six hours in Summer Session I and six hours in Summer Session II; or
4. Six hours in Summer Session I, six hours in Summer Session II, and twelve hours in the following Fall semester.

Receipt of a grade below C generally presages dismissal from the School. Each student must satisfactorily complete a comprehensive examination within one regular semester, excluding summer sessions, following completion of the core courses.

By the end of a student's second year in the School, the student either must be granted an exemption from or have passed core courses, MS 501, 502, 503, 504, and 505.

In addition to the core courses above, MS 628 is required for all students in biological oceanography and MS 619 is required for all students in marine fisheries science.

All active students (i.e. those working toward completion of a degree program who have not been granted leave), whether in residence or not, must register for a minimum of three (3) hours each semester, and one (1) hour for each summer session. Students must be registered in the semester during which they graduate.

Reading knowledge of one foreign language is required for either the M.A. or Ph.D. degree. Candidates for the doctorate who have passed a language examination for the master's degree in the School of Marine Science need not take another language examination. Subfaculties and individual committees may adopt additional language requirements at their discretion.

The student may fulfill the language requirement by completing one of the following:

1. At least six (6) semester hours in one pertinent foreign language (German, French or Russian are recommended) at the college sophomore level or above with grade of B or better; or
2. Obtain a score no lower than the forty-fifth percentile in the Educational Testing Service Foreign Language Examination; or
3. Pass an examination administered by a member of the Department of Modern Languages who is competent in the language.

Students whose native language is not English may, with the permission of the Dean, use English to fulfill the foreign language requirement. Proficiency in the use of the English language may be demonstrated by the
completion of twelve (12) credit hours of formal class work with grades of B or higher in the School of Marine Science. Upon recommendation of the Academic Status and Degrees Committee of the faculty, the Dean may approve alternate methods.

**Degree of Master of Arts**

The steps to be accomplished and requirements for the degree are as follows:

1. As soon after initial registration as possible, the student must select a major professor, an advisory committee and a research project. The major professor, working with the committee, will prescribe the student's program which will include the required courses.

2. The major professor and advisory committee, chosen by the student and approved by the Dean, direct the student's program. The advisory committee consists of five faculty members (three full members and two examining members) from the School of Marine Science. For students with a concentration in biology or marine fisheries science, at least one of the members must be from physical, chemical or geological oceanography. For students with a concentration in physical, chemical or geological oceanography at least one member must be from biological oceanography or marine fisheries science. For students with a concentration in marine resource management, one member must be from physical, chemical or geological oceanography and one from either biological or marine fisheries science.

3. At least one year of each student's program must be spent as a full-time resident student as defined in the general degree requirements presented above.

4. At least twenty-four (24) semester credits of advanced work, of which at least one-half must have been earned in courses numbered 600 or above and with a grade average of B or better, are required for the M.A. degree. In addition master's students are required to register for at least six (6) semester hours of MS 560 (Thesis).

5. Upon a favorable recommendation of the student's advisory committee and the Academic Status and Degrees Committee, followed by a majority vote of the faculty of the School of Marine Science and the approval of the Dean, a student may be admitted to candidacy after completion of the following requirements:

   a. The student must have achieved a grade point average of B (3.0) or better, averaged over all courses taken for credit at the time of application for admission to candidacy.

   b. All core courses required by the School of Marine Science, including MS 501, MS 502, MS 503, MS 504 and MS 507, must be passed or officially exempted and all other courses specifically required by the student's advisory committee must be completed.

   c. The Language requirement and the comprehensive examination must be satisfactorily completed.
6. The student must present and defend a thesis approved by major professor, advisory committee and Dean. The defense of the thesis shall be separate from any other examination. The thesis must be submitted in final form to the college two weeks before the student expects to receive the degree. The degree will not be granted until 5 copies (approved and signed by the major professor and the committee and prepared for binding), one of which is the original, have been presented by the student to the authorities as required by the College. Detailed information regarding procedures for submission of the thesis should be obtained from the Office of the Dean.

7. All requirements for the degree must be completed within six (6) calendar years after commencing graduate study. In exceptional cases, if recommended by the appropriate faculty committee, time extensions may be approved by the Dean.

**Degree of Doctor of Philosophy**

The steps to be accomplished and the requirements for the degree are as follows:

1. The student must select a suitable major professor as soon as possible following admission. The student and the major professor will choose an advisory committee, which must be approved by the Dean. The major professor and advisory committee direct the student’s program.

2. Course requirements will be established and approved by the student’s major professor, in cooperation with the advisory committee, and approved by the Dean.

3. The advisory committee must consist of at least five members, one of whom must be from outside the School of Marine Science. The major professor, who must be a faculty member of the College, will serve as the committee’s chairman. A majority of the committee must be faculty members of the College, although qualified persons from outside the College may be included. For students with a concentration in biology or marine fisheries science, one member must be from physical, chemical or geological oceanography. For students with a concentration in physical, chemical or geological oceanography, one member must be from biological oceanography or marine fisheries science. For students with concentration in marine resource management, one member must be from physical, chemical or geological oceanography and one from biological or marine fisheries science.

4. A minimum of three years of graduate study beyond the baccalaureate is required. At least one academic year beyond the first must be spent in residence as a full-time student of The College of William and Mary at either the Williamsburg or the Gloucester Point campus, or both as defined in the general requirements above.

5. In addition to and separate from the comprehensive examination, the student must satisfactorily complete a qualifying examination to demonstrate factual and theoretical knowledge in the student's field of specialization and in other subject areas as required by the student's advisory committee.
6. Admission to candidacy the same as listed in Degree of Master of Arts section except that the separate qualifying examination also must be satisfactorily completed.

7. The dissertation must be submitted to the college two weeks before the date of commencement.

8. Each candidate must successfully defend the dissertation in a final examination before it can be accepted by the College. This examination may be written or oral at the discretion of the School of Marine Science and shall be open to the faculty and to such outside persons as may be invited. This examination shall be separate from any other examination.

9. All graduate work in the School of Marine Science must be accomplished within seven (7) calendar years after beginning work for the doctoral degree. In exceptional cases, if recommended by the appropriate faculty committee, extensions may be approved by the Dean.

10. All dissertations will be published by having a master microfilm negative made from each original dissertation. These negatives will be stored and serviced by "University Microfilms" of Ann Arbor, Michigan, and positive microfilms, or enlarged prints, will be produced to order at the standard rate for other scholars who desire access to any dissertation. Each dissertation, when submitted, must be accompanied by two copies of an abstract of not more than 350 words. This abstract, or summary, will be published in Microfilm Abstracts for national distribution. No dissertation will be accepted without this abstract. A fee of $25 for the above services must be paid by the candidate for the Doctor of Philosophy degree before it is conferred. All dissertation research should be planned, conducted and reported with a view toward publication of the results in a legitimate scientific journal.

FINANCIAL INFORMATION

TUITION AND FEES. The College reserves the right to make changes in its charges for any and all programs at any time, after approval by the Board of Visitors.

The tuition and general fee for full-time students in the School of Marine Science is $1,145 per semester for residents of Virginia and $3,084 per semester for others.

SPECIAL NOTE. Effective September 1, 1981, all incoming students registered for NINE (9) hours or more in 500-level courses or above, or for TWELVE (12) hours or more at any level, will be considered full-time students and charged the full-time rates approved by the Board of Visitors of The College of William and Mary.

Tuition for part-time students, at both the undergraduate and graduate levels, is as follows:
- $77 per semester hour for Virginia students.
- $206 per semester hour for out-of-State students.

Regularly enrolled degree-seeking students of the College will be charged these rates during the regular session for part-time work, based on their established domiciliary status.

Rates for students who enroll in the Summer Session will be charged on the same basis.

The diploma fee is $20.00 for all degrees.
Part-time students who are not regularly enrolled at The College of William and Mary, and for whom, therefore, no domiciliary status previously has been determined, will be charged on the basis of their satisfactorily established domiciliary status. (See statement regarding in-State, out-of-State classification for fee purposes).

Auditing fees are the same as those specified for part-time students, unless the auditor is a full-time student.

**ELIGIBILITY FOR IN-STATE TUITION RATE.** To be eligible for the lower tuition rate available to in-state students, a student must meet the statutory test for domicile set forth in Section 23-7.4 of the Code of Virginia. Domicile is a technical legal concept, and a student's status is determined objectively through the impartial application of established rules. In general, to establish domicile students must be able to show (1) that for at least one year immediately preceding the first official day of classes their permanent home was in Virginia and (2) that they intend to stay in Virginia indefinitely after graduation. Residence in Virginia primarily to attend college does not establish eligibility for the in-state tuition rate.

On admission to the College an entering student who claims domiciliary status is sent an application form and instructions on how to fill it out. The Office of the Registrar evaluates the application and notifies the student of its decision. A student re-enrolling in the College after an absence of one or more semesters must re-apply for domiciliary status and is subject to the same requirements as an entering student. A matriculating student whose domicile has changed may request reclassification for out-of-state to in-state; since reclassification is effective only prospectively, however, it must be applied for before the beginning of the academic semester. Any student may ask for written review of an adverse decision, but a change in classification will be made only when justified by clear and convincing evidence. All questions about eligibility for domiciliary status should be addressed to the Office of the Registrar.

**PAYMENT OF ACCOUNTS**

Charges for the tuition and general fee are payable in advance by the semester. Registration is not complete until all fees due the Treasurer's Office are paid. Any unpaid balance on an individual's account could result in cancellation of registration. Remittance being made by check should be drawn to The College of William and Mary. Checks returned by the bank for any reason will constitute nonpayment of fees and will result in subsequent cancellation of registration.

**REFUNDS TO STUDENTS WHO WITHDRAW FROM COLLEGE.** Subject to the following regulations and exceptions, all charges made by the College are considered to be fully earned upon completion of registration by the student. Due to administrative procedures, refunds will not be processed until six (6) weeks after classes begin.

1. A student who withdraws within the first five-day period immediately following the first day of classes is entitled to a refund of all charges, with the exception of $50.00 which shall be retained by the Col-
lege to cover the costs of registration, subject to Item No. 5, below. (Such refunds shall not include any deposits or advance payments which may have been required by the College as evidence of the student’s intention to enroll.)

2. A student who withdraws at any time within the next following 25 days after the first day of classes shall be charged 25% of the tuition and general fee, subject to Item No. 5 below.

3. A student who withdraws at any time within the second thirty-day period after the first day of classes shall be charged 50% of the tuition and general fee, subject to Item No. 5 below.

4. A student who withdraws at any time after 60 calendar days following the first day of classes shall be charged the full tuition and general fee, subject to Item No. 5 below.

5. No refunds will be made to a student who has been required by the College to withdraw, regardless of the date of withdrawal.

6. No refunds will be made to a student who withdraws unofficially.

7. A registration fee of at least $50.00 will be deducted from the amount due and paid by a part-time student who withdraws within 60 calendar days immediately following the first day of classes, except in the case of an in-State student who is registered for only one credit hour. In such a case, the student will receive no refund.

If the total amount due and paid is more than $100.00, a maximum of 50% of that total will be refunded. The graduated refund policy noted for full-time students will not apply to part-time students.

No refund will be granted to a part-time student who withdraws after 60 calendar days immediately following the first day of classes; or who has been required by the College to withdraw, regardless of the date of withdrawal; or who withdraws unofficially.

At the graduate and/or law school level, a part-time student is one who is enrolled for 8 credit hours or less. An exception to this rule is noted in the Financial Information section.

CREDITS ON ACCOUNTS OF HOLDERS ON SCHOLARSHIPS. Students holding scholarships are required to pay all fees less the value of the scholarship which they hold. In cases where scholarships exceed total charges, refunds will be processed upon written request of the student beginning six (6) weeks after classes begin.

WITHHOLDING OF TRANSCRIPTS AND DIPLOMAS IN CASES OF UNPAID ACCOUNTS. Transcripts or any other information concerning scholastic records will not be released until College accounts are paid in full. Diplomas will not be awarded to persons whose College accounts are not paid in full.

Students may not drop a course after the last day of classes. If for medical reasons a student does not complete a course, “W” with the appropriate notation will be entered on the record upon approval of the Dean and the appropriate authorities at the College.
ADMISSIONS

APPLICATION. Requests for application forms and completed application materials should be sent to:
Dean's Office, Admissions
School of Marine Science
The College of William and Mary
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

Normally applications close for the Fall term on February 15, for the Spring term October 1, and for the Summer Session on January 15. Successful applicants for fall admission will be notified by April 7, for spring admission by November 7. Late applications will be evaluated up until classes begin, but the process for late applicants is less programmed, and, therefore, no notification dates can be promised.

The following are required of applicants to the School of Marine Science:
1. Two (2) copies of the completed application form.
2. A non-refundable processing fee of $20.00. This fee is not credited to the student's account. There is no fee application for admission as an unclassified (post-baccalaureate) student.
3. Three (3) letters of recommendation.
4. Official transcripts of all college work.
5. Scores of the Verbal, the Quantitative, and at least one Advanced Graduate Record Examination (GRE).

Applicants must register for these tests directly with the Educational Testing Service, Princeton, New Jersey. The registration forms may be obtained from the Office of the Dean.

FOREIGN-EDUCATED STUDENTS. Additionally, foreign students must submit the results of the GRE English Language Proficiency Test, Test of English as a Foreign Language (TOEFL).

In order to expedite evaluation of records of foreign-educated students, the transcripts of college records must include, titles of courses taken, the number of credits attempted and credits earned, and grades. Where transcripts do not give these details, they must be accompanied by an official statement explaining how the scholastic record may be compared to that of The College of William and Mary. Details must be given as to whether the courses are given on a semester basis (15 credits per semester, 30 per year, 120 for graduation), quarter basis (15 credits per semester, 45 per year, 180 for graduation) or other basis. In addition, the grading scale must be explained showing the grade equivalence in terms of A (highest) B, C, (passing), F (failing).

ADMISSION. Students are admitted as regular or provisional graduate students, or as unclassified students (post-baccalaureate). For admission as a regular graduate student an applicant must have completed the requirements for a bachelor's degree at an accredited college, with a record of high performance, and must have the recommendation of the appropriate committee and officials of the School. For direct admission of a doctoral student an applicant must have an earned master's degree or equivalent in
an appropriate field and the recommendation of the appropriate committee and officials of the School.

An applicant with a bachelor's degree and with a deficiency in some area may be admitted as a provisional student. A provisional student may be admitted to regular student status upon completion of at least 10 semester hours of graduate work at the School of Marine Science and favorable recommendation of the Academic Status and Degrees Committee, followed by a majority vote of the faculty of the School of Marine Science and approval by the Dean. Graduate credit earned by a provisional student is applied toward the graduate degree upon admission as a regular graduate student.

Applicants who have received a bachelor's degree from an accredited college or university and who wish to take courses in the College but not to enter a program for an advanced degree, may apply for admission as unclassified students (post-baccalaureate). Graduate credit earned by an unclassified student is applied toward the graduate degree upon admission as a regular graduate student.

Students, except unclassified students, are admitted to either the Master of Arts or Doctor of Philosophy program. A superior student whose original acceptance was to the master's program may petition for permission to bypass the master's degree and proceed directly toward the doctorate. The petition, which should be submitted to the Committee on Academic Status and Degrees, may not be submitted until the student has successfully completed the comprehensive examination and must have the support of student's advisory committee. At a minimum the student's advisory committee must demonstrate its support with a written statement that the student has begun work on a research project that the committee finds acceptable as the basis for a doctoral dissertation, and that it is the consensus of the Committee that the student has demonstrated sufficient level of excellence to be allowed to proceed with work leading directly to the doctorate. After reviewing the petition and supporting documents, the Committee on Academic Status and Degrees will make a recommendation to the Dean as to whether or not permission to bypass the master's degree should be granted. Authority for the final decision rests with the Dean.

GENERAL INFORMATION

FINANCIAL AID. Application for aid should be made on the application form for admission to graduate study. Awards are made on the basis of merit. Graduate assistants work twenty hours a week. They must satisfactorily carry out the duties assigned by the School of Marine Science, must make satisfactory progress on their programs as defined by the College degree requirements and the regulations of the School of Marine Science, and may not hold any other employment or appointment of a remunerative nature during the term of their assistantships without approval of the Dean of the School of Marine Science. Failure to comply with these conditions will lead to revocation of appointments.

For information regarding the College Work-Study, National Direct Student Loan, and Guaranteed Student Loan Programs, write to: Director of Student Financial Aid, The College of William and Mary, Williamsburg, Virginia 23185.
VIRGINIA WAR ORPHANS EDUCATION PROGRAM. The Virginia War Orphans Education Program provides educational assistance for children, or surviving children, of certain veterans or service personnel. To be eligible for assistance under this program, an applicant must meet the following basic eligibility requirements:

1. The applicant must be no less than sixteen (16) years of age, or no more than twenty-five (25) years of age.

2. One of the applicant’s parents must have served in the armed forces of the United States; and must be permanently and totally disabled due to an injury or disease incurred in a time of war or other period of armed conflict; or

3. One of the applicant’s parents must have died as a result of injury or disease incurred in a time of war or other period of armed conflict; or

4. One of the applicant’s parents must be listed as a prisoner of war or missing in action.

5. The applicant’s parent, on which eligibility is based, must have been a resident of the Commonwealth of Virginia at the time of entry into active military duty; or

6. The applicant’s parent, on which eligibility is based, must have been a resident of the Commonwealth of Virginia for at least ten (10) consecutive years immediately prior to the date of application.

7. The applicant must provide written verification attesting to his or her acceptance as a student in either a state-supported secondary or post-secondary educational institution.

Eligible individuals are entitled to a maximum of forty-eight (48) months of tuition-free education at state-supported educational or training institutions. Individuals entitled to this benefit may utilize it to pursue any vocational, technical, undergraduate, or graduate program of instruction. Generally, programs listed in the academic catalogs of state-supported institutions are acceptable provided they have a clearly defined educational objective, i.e.: certificate, diploma or degree.

Requests for applications should be directed to the Director, Division of War Veterans’ Claims, Commonwealth of Virginia, 210 Franklin Road, S.W. Roanoke, VA 24011. If possible, applications should be submitted at least four (4) months before the expected date of matriculation.

TRANSFER OF GRADUATE CREDIT. On the recommendation of the Academic Status and Degrees Committee and the approval of the Dean of the School, a regular student may apply up to six hours of graduate credit earned at another accredited institution of higher learning toward an advanced degree at William and Mary. The credits must have been earned in courses appropriate to the student’s program in the School and must fall within the time specified by the general college requirements for degrees. Credit may be transferred only for courses in which the student received a grade of B or better and may not be counted in compiling his or her quality point average at William and Mary.

CHANGES IN REGISTRATION. All changes in students’ schedules after the close of registration will be initiated through the School, and require approval of the instructors involved, the student’s advisor or major professor, and the Dean. Students may not add courses after the last day
for changes in registration as indicated in the calendar. If the student drops a course or courses before mid-semester but remains registered for other academic work, the course or courses dropped will be removed from the student’s record. If the student drops a course or courses after mid-semester through the last day of classes, but remains registered for other academic work, the grade of “W” or “F” will be awarded by the instructor in the course depending upon whether or not the student was passing at the time the course was dropped.

If the student withdraws from the College before mid-semester, a grade of “W” will appear on the record for each course in progress at the time of withdrawal. After mid-semester through the last day of classes, students who withdraw from the College will be awarded a “W” or “F” by the faculty member teaching each course in progress at the time of the withdrawal.

EXAMINATIONS. The examinations, given at the end of each semester, take place at the times announced on the examination schedule. Students are required to take all of their examinations at the time scheduled unless excused by the instructor or Dean on account of illness or other sufficient reason. Whenever possible, students must make their request to be excused from an examination in advance of the examination. Permission to take a deferred examination must be obtained from the instructor and the Dean. Students excused from an examination will have “I” entered on the record until they make up the examination. Deferred examinations must be made up by the end of the following semester.

THE HONOR SYSTEM is one of the College’s most treasured traditions. Every student at the College is bound by its tenets, which are at the basis of all scholarship. The Graduate Student Association administers the system for graduate students of the School of Marine Science. The principles of the Honor System and the method of administration are described in the Student Handbook.

SEXUAL HARRASSMENT. The following policy statement on sexual harassment has been approved “in spirit” by the faculty of marine science of the College:

Every member of the College community has the right to work, study, teach and conduct research in an environment free from sexual pressure of any kind. Sexual harassment is an infringement on that right and will not be tolerated in any form.

On the other hand, the College recognizes that interpersonal rapport between students and faculty is a natural and desirable aspect of the college experience. Faculty should be aware, however, that a situation in which they have a dual relationship with a student - a professional as well as a less formal relationship - has the inherent potential for exploitation. Particularly astute judgment should be exercised when a faculty member is in a position to give grades, letters of recommendations or grants to a student with whom he or she also has a less formal relationship. In the view of the College, the above described dual relationship is clearly subject to exploitation due to the power imbalance involved.

Any student with a grievance within this policy should first inform immediately the offending party of the unwelcome character of the behav-
ior. If the behavior persists, or if there are any apparent reprisals, the student should inform the relevant department chairman or dean, who, within standing procedures governing imposition of sanctions for misconduct of a faculty member, is charged with responsibility for making inquiries and, if the evidence warrants it, prosecuting the matter within stipulated Faculty Handbook procedures.

For a student who believes he or she may have been sexually harassed but is uncertain as to whether a complaint is justified or whether he or she wishes to initiate a formal grievance, it may be helpful to discuss his/her concerns confidentially and informally with the Director of Equal Opportunity and Affirmative Action Programs or with a staff member of the Center for Psychological Services.

SUBMISSION OF THESSES AND DISSERTATIONS. Detailed procedures regarding submission of theses and dissertations and payment of binding fees may be obtained from the Dean's Office.

NOTICE OF CANDIDACY FOR GRADUATION. Candidates for advanced degrees must submit a Notice of Candidacy for Graduation to the Registrar at the beginning of the semester in which they expect to receive the degree. If they subsequently fail to complete the requirements, they must cancel the notice at least two weeks before the date of Commencement and must resubmit the notice in whatever semester they complete the requirements. Students should pay the diploma fee at the Treasurer's Office. No bill for this fee will be sent separately to the student.

SYSTEM OF GRADING AND QUALITY POINTS. The grades A (excellent), B (good), C (satisfactory), or in certain courses, P (pass), and F (failure) are used to indicate the quality of work in a course. "W" indicates that a student withdrew from the College before mid-semester or dropped a course between mid-semester and the last day of class and was passing at the time that the course was dropped.

For each semester credit in a course in which a student is graded A, 4 quality points are awarded; B, 3; C, 2; P carries credit but is not included in a student's quality point average; F carries no credit but the hours attempted are included in the student's average.

In addition to the grades A, B, C, P, F, and "W," the symbols "G" and "T" are used on grade reports and in the College records. "G" indicates that the instructor has deferred reporting the student's grade since there is not sufficient evidence on which to base a grade.

"I" indicates that because of illness or other major extenuating circumstances, the student has postponed, with the explicit consent of the instructor, the completion of certain required work. In case of absence from the final examination for reasons of illness or other good grounds, "I" automatically becomes "F" at the end of the next semester if the postponed work has not been completed.