OCEAN SCIENCES

https://www.graduate.rsmas.miami.edu/graduate-programs/ocean-sciences/index.html

Dept. Code: OCE

The mission of the Ocean Sciences (OCE) graduate program is to provide our students with specialized knowledge in important ocean science sub-disciplines as well as a broad understanding of the ocean as a key component of the Earth System. Our students advance the understanding of physical, chemical, and biological processes in the ocean and their interactions. Students learn first-hand about instrumentation and methods to measure the ocean using both in-situ and space-based sensors, and about laboratory, analytical, and numerical models to understand oceanic processes. Our graduates develop into international leaders of ocean research, into teachers and communicators of ocean sciences, and into leaders and advisors of marine education, policy, and conservation.

OCE offers opportunities for students to participate in research cruises and join field campaigns aboard our research vessel *Walton Smith* and aboard other vessels around the world, to perform experiments in our state-of-the-art wind-wave-storm surge simulator (SUSTAIN), and to run ocean and climate model simulations using our supercomputer facility. The OCE faculty excels in a wide range of topics including ocean circulation and climate, ocean carbon cycle, air-sea interaction, remote sensing, and marine ecosystem dynamics.

Degree Programs

- Master of Professional Science (M.P.S.) (p. 2)
  - Requires 30 credit hours, including 24 course credit hours and 6 internship credit hours.
- Master of Science (M.S.) (p. 2)
  - Requires 30 credit hours, including 24 course credit hours and 6 research credit hours.
- Doctor of Philosophy (Ph.D.) (p. 2)
  - Requires 60 credit hours, including a minimum of 27 course credit hours and a minimum of 12 research credit hours.

Research Areas

When admitted to the OCE graduate program, students will choose a research concentration based on their research interests.

Ocean Dynamics

This concentration covers the study of how the ocean moves on all scales, from turbulence and eddies to ocean gyres and the global thermohaline circulation, and how these motions impact and interact with Earth's climate. Scientists in OCE approach studies of Ocean Dynamics through sea-going experimentation and data analysis, development of conceptual modeling tools, data assimilation, numerical simulations, ocean prediction, and forecasting. Research topics include the dynamics and variability of boundary currents like the Gulf Stream, basin-wide meridional overturning and heat transport, mesoscale and submesoscale dynamics and stirring, turbulence, water mass formation and ventilation, oil spills, and coastal and continental shelf processes.

Air-Sea Interaction and Remote Sensing

The focus of this concentration is on sub-millimeter to mesoscale processes at and across the air-sea interface, from the oceanic thermocline to the atmospheric boundary layer. Research topics include surface fluxes and turbulent mixing events, wind-wave-current interactions, hurricane intensity changes, storm surge predictions, coupled tropical dynamics, underwater acoustics, internal and surface gravity waves, and coastal processes. OCE faculty, research staff, and students approach these studies using our unique wind-wave laboratory (SUSTAIN) and satellite-data facilities (CSTARS), and through field experimentation using ship-, buoy-, land-, and aircraft-based instrumentation. Coupled ocean-atmosphere modeling studies provide a framework to understand these observations, where one of the foci is tropical weather and hurricanes. Many of our research efforts have societal relevance in areas such as severe weather and wave forecasting, disaster monitoring and mitigation response, climate change, renewable energy developments, marine transportation and ship tracking, search and rescue, and pollutant dispersion.

Marine Biogeochemistry

Studies in this concentration focus on the physical, chemical, biological, and geological processes controlling the oceanic cycling of carbon, macronutrients (nitrogen, phosphorus, and silicon), and trace elements (e.g., iron). We conduct our work throughout the global ocean using advanced analytical and modeling techniques to assess the dynamics of these elements. Research topics include ocean acidification, nutrient limitation of productivity, global distributions of biogeochemical variables, tracers for time scales of water mass formation and circulation, air-sea exchange of materials, carbon fluxes, microbial processes, and speciation, distribution, and isotopic ratio of dissolved trace metals.

Biophysical Interactions

This concentration addresses the study of ocean productivity, the distribution, transport, and behavior of planktonic organisms, and their complex interactions with higher trophic levels. Researchers in OCE take a multi-prong approach, coupling the development of biophysical models with experimental field and laboratory work. OCE scientists develop new techniques and instrumentation to observe and model planktonic organism behavior and their responses to environmental signals. Research topics include the study of harmful algal blooms, plankton distribution and patchiness, trophic interactions, larval dispersal and population connectivity, biological control of physical constraints, microbial dynamics, bioacoustics, and animal navigation.

Master of Professional Science (M.P.S.) Programs

There are two OCE tracks for the M.P.S. degree:

- M.P.S. in Applied Remote Sensing (ARS) (http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/ocean-sciences/applied-remote-sensing-mps/)
- M.P.S. in Natural Hazards and Catastrophes (NHC) (http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/ocean-sciences/natural-hazards-and-catastrophes-mps/)

Master of Science (M.S.) Program

- M.S. in Ocean Sciences (OCE) (http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/ocean-sciences/ocean-sciences-ms/)

Doctor of Philosophy (Ph.D.) Program

- Ph.D. in in Ocean Sciences (OCE) (http://bulletin.miami.edu/graduate-academic-programs/marine-atmospheric-science/ocean-sciences/ocean-sciences-phd/)

OCE 602. Oceanography II (Physical). 2 Credit Hours.
The second section of the course core curriculum designed as an integrated and multidisciplinary view of ocean processes, covering the major disciplines of marine science and their applications to the study of the marine environment. To be taken in sequence with Oceanography I - Geological (MGG 501), Oceanography I II - Chemical (MAC 501), and Oceanography IV - Biological (MBF 502). This course is for non-MPO majors only.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 603. Physical Oceanography. 3 Credit Hours.
Introduction to properties of seawater, instruments and methods, heat budget, general ocean circulation, formation of water masses, dynamics of circulation, regional oceanography, waves, tides, and sea level. A mathematical and problem solving course for majors in MPO.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 606. Introduction to Ocean Remote Sensing. 3 Credit Hours.
This course is intended to provide undergraduate and graduate students with a complete overview of the most important ocean remote sensing techniques using passive (radiometers, cameras) and active instruments (mostly radar) on space- and airborne platforms, towers, ships, and land. PhD, MS, and MPS students who take this course can take the complementary course, OCE/MPO 707, in parallel or at a later time to gain further in-depth knowledge of the field. MPS students on the track Applied Remote Sensing are required to take both courses. Successful completion of undergraduate courses on calculus, statistics, and physics is desirable.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 608. Introduction to Ocean Systems Engineering. 3 Credit Hours.
This course will provide a survey introduction to various aspects of ocean systems engineering. This is a required course for all students enrolled in the Master of Science (non-thesis) in Ocean Engineering Program. It is intended to be taught in the first term of their studies, before they have fully refined their courses. It could also be of interest to graduate students in OCE and upper level undergraduate engineering, marine science or mathematics majors who are seeking to inform themselves on the breadth of study in ocean engineering.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 609. Coastal Physics and Engineering. 3 Credit Hours.
Course addresses linear wave theory, wave statistics, wave generation, tides, wind-driven currents, nearshore circulation, sediment transport by waves and currents, bedforms, bedload, and suspended load. Other topics include longshore and cross-shore transport, equilibrium beach profiles, coastal processes models, Pelnard-Considere model for shoreline change, and Escoffier model for inlet stability.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 610. Ocean Biogeochemistry. 3 Credit Hours.
Introductory course to understand the ocean as a system. It will cover the interactions between biological, chemical, and geological processes in the environment, all within the context of physical controls. In the ocean, biogeochemistry includes the cycling of both major (e.g., C, N, P, Si, 0) and minor elements (such as Fe). Tracing the spatial and temporal variability of these elements provides insights on the biological and geochemical processes at work, as well as the hydrographic and other controls on those processes. In this course, the physical ocean system is introduced in the context of its controls on the biological system, which in turn controls distributions of bioactive elements. Considered here are the major processes controlling ocean productivity, its roles as a carbon sink, organic matter production and consumption, the cycling of nutrients, the inorganic carbon system, and biogeochemistry of the sediments.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 611. Geophysical Fluid Dynamics I. 3 Credit Hours.
The basic equations of state, continuity, and motion. Topics include wave motions, group velocity, theory of stratified fluids and internal waves turbulence.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 612. Marine Organic Geochemistry. 3 Credit Hours.
Broad introduction to the chemical constituents comprising organic matter in marine environments. This course will address how biological origins, dietary and detrital reworking, and physical phase influence the distribution and fluxes of organic matter in the marine carbon cycle, on both short and long timescales. Topics will address both the water column and sediments, in open-ocean and coastal environments. Students may choose topics of specific interest to their research for presentations and writing assignments (subject to instructor approval). The first half of the course will focus on the chemistry and physical phases of organic matter; the second half will focus on discussing the application of organic geochemical tools to environmental questions via the primary literature.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 615. Tracers of Oceanographic Processes. 3 Credit Hours.
Course describes the various tracer techniques used by oceanographers to understand water transport and mixing, sedimentation, gas exchange, nutrient recycling, and transport. Tracers used are both natural occurring and anthropogenic. This course is of interest to students from various disciplines.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 622. Marine Microbial Dynamics. 3 Credit Hours.
An overview of the function of microbes in the ocean from a chemical perspective, building a quantitative understanding of cellular needs and metabolic functions, and the role these microbial processes play in controlling chemical fluxes and biogeochemical cycles in the ocean.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 624. Applied Data Analysis. 3 Credit Hours.
The course is intended to jump-start students in strategies for fruitful computer interaction practices for careers in MPO areas of science. Academic topics include key concepts in probability & statistics, issues of graphical evidence and inference, linear models and regression, spectral analysis, and matrix decomposition. Practical topics include hands-on exercises in data analysis and the sharing of code+results and interpretation. Students do projects on data from their research or interests.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 631. Ocean Data Analysis. 3 Credit Hours.
Useful and widely used ocean data analysis techniques are discussed. Topics covered include: a review of statistical concepts and linear algebra; time series analysis; least squares and regression techniques; principal component analysis; optimization and inverse methods; and simple models of ocean processes. Computational methods are emphasized. Choice of the material covered is dictated in part by student interests.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 635. Introduction to Underwater Acoustics. 3 Credit Hours.
Course topics include sound waves and pulses, harmonic analysis, sound propagation in the ocean, sonar systems, scattering and absorption, acoustic measurement of marine life and sea-floor properties, sound transmission in waveguides, ambient noise, transducers, and hydrophones.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 636. Hurricanes. 3 Credit Hours.
This course is intended to provide a broad overview of tropical cyclones, starting from the basic structure, dynamics and thermodynamics, then expanding through to observations, modeling, forecasting and impacts.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 637. Natural Hazards: Atmosphere and Ocean. 3 Credit Hours.
This course is designed to provide students with an understanding of natural hazards in both the atmosphere and ocean. In the atmosphere, we will explore both weather events such as storms and hurricanes and tornadoes as well as longer term phenomena such as monsoons and excess rainfall in the tropics. Oceanographically, the course will address hazards such as storm surge and flooding, rogue waves, rip currents, and tsunamis that occur on short time scales as well as the longer terms effects such as sea level rise and the impacts of El Niño and La Niña oceanographic conditions on weather conditions. Thus, the course focus is on hazards and their impacts around the globe.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 643. Physics of Remote Sensing II - Active Systems. 3 Credit Hours.
Course discusses basic physical principles of remote sensing with emphasis on active and radar systems. Topics include electromagnetic theory, radar equation, antenna theory and pulse compression, radar scattering physics; sea surface processes relevant to radar imaging, scatterometry, synthetic aperture radar (SAR), altimetry, HF Doppler radar, marine radar, satellite orbits, brief overview of passive remote sensing techniques.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 651. Applied Ocean Acoustics and Marine Mammals. 3 Credit Hours.
The objective of this course is to provide a basis in the fundamental of sound in the sea and on the effects of sound on marine mammals.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 668. Marine Isotopic Processes. 3 Credit Hours.
The use of isotopic methods in geology, geochemistry, and geophysics including oceanography and meteorology. General laws governing isotopic effects in chemical and physical processes are discussed as well as specific problems in dating, tracing, and paleotemperatures.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 673. Applied Underwater Acoustics. 3 Credit Hours.
Course topics include sonar systems and operating characteristics, scattering and reverberation, target strength, signal processing, transducers and arrays, detection and noise, and acoustic telemetry.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 675. Fluid Mechanics. 3 Credit Hours.
The equations governing the dynamics of homogeneous fluids are derived. The concepts of deformation rates, vorticity, stream function, and ideal fluid flow are introduced and demonstrated in applications describing flows in the marine environment. Semi-empirical methods for analyzing viscous flows, boundary layers, and turbulence are presented. Eddy viscosity and more advanced turbulence closure schemes are discussed in the context of coastal circulation, bottom boundary layers and sediment transport.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 676. Wave Propagation in the Ocean Environment. 3 Credit Hours.
Review of vector analysis, basic principles of fluid mechanics, equations of surface gravity waves, linear dispersion relation, phase and group velocity, wave dispersion, orbital motions, wave refraction, diffraction, reflection, ray tracing, frequency and wavenumber spectra, fundamentals of wave modeling, action balance equation, wave generation, wave dissipation, wave-wave interaction, wave-current interaction, Stokes drift, internal waves.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 680. Transport and Mixing Process in the Marine Environment. 3 Credit Hours.
Heat and constituent transport and mixing processes in the marine environment. Derivation of the fundamental equations governing heat and constituent transport and mixing processes, steady and unsteady state heat transfer by conduction, laminar and turbulent convection, and radiation, steady and unsteady state constituent transfer by diffusion and laminar and turbulent convection, mixing and flushing in tidally driven coastal waters are also discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 681. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 682. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 683. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 684. Special Topics. 1-4 Credit Hours.
Lectures, research projects or directed readings in special topics.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 701. Mathematical Methods in Marine Physics. 3 Credit Hours.
Review of linear algebra with emphasis on real symmetric systems. Least squares, optimal estimation, and the Gauss-Markov theorem. Equilibria in discrete and continuous systems, and the foundations of continuum mechanics. Review of vector and tensor analysis. Calculus of variations and the variational principles of mechanics. Fourier analysis and orthogonal expansions. Integral transforms. The discrete Fourier and z transforms. Functions of a complex variable. Ordinary differential equations. Dynamical systems, the phase plane, stability, and an introduction to chaos. The diffusion equation. Linear and nonlinear wave equations. Applications to marine physics involving wave motion and fluid flow are emphasized throughout the course.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 705. Chemical Oceanography. 3 Credit Hours.
This course will introduce students to the chemistry of the oceans, descriptive chemical oceanography of the components of ocean waters (metals, gases, organic compounds and nutrients), and biogeochemical cycles in oceanic systems.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 707. Advanced Ocean Remote Sensing. 3 Credit Hours.
This course is intended to provide graduate students with additional in-depth knowledge on the topics covered by MPO/OCE 606. PhD, MS, and MPS students can take this course together with the introduction course or at a later time. MPS students on the track Applied Remote Sensing are required to take both courses. Successful completion of undergraduate courses on calculus, statistics, and physics and some experience in coding and/or data analysis on a computer is desirable. A laptop computer is required to participate in image analysis exercises and some homework assignments.
Prerequisite/Co-requisite: MPO 606 Or OCE 606.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 711. Geophysical Fluid Dynamics II. 3 Credit Hours.
The focus of this course is on the effects of stratification, on time variable phenomena, and on the interaction between large-scale circulation and mesoscale eddies. Course topics include quasi geostrophic scale analysis, Rossby waves, barotropic and baroclinic instability, wave-mean flow interaction and non-geos trophic waves.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 712. Large Scale Ocean Circulation: Models and Observations. 3 Credit Hours.
Course topics include theoretical models of the oceanic current systems, wind-driven and thermohaline circulation, effects of bottom topography, and lateral bounding.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 716. Lagrangian Fluid Dynamics and Predictablity. 3 Credit Hours.
The ash cloud produced by the eruption of Eyjafjallajokull in Iceland, the oil spill produced by the explosion of the Deepwater Horizon drilling rig in the Gulf of Mexico, and release of debris and radioactive contamination into the Pacific Ocean after the Fukushima nuclear reactor was hit by the Tohoku tsunami, are examples of events that have caused considerable impact to the environment. They all represent problems in Lagrangian ocean or atmospheric dynamics in which predicting where the material released into the environment will be transported by the ocean currents or winds is critical. A common approach to predict the outcome of an event like the above is to run an ocean or atmosphere circulation model simulations and then integrate the resulting velocity fields from a given release location to predict pollutant trajectories. An important drawback of such an approach is that the predictions are highly sensitive to small changes in the release time and location. Attempts to cope with the sensitivity to initial conditions include running several different models for the same scenario, but this typically leads to even larger distributions of advected tracers, hiding the key organizing structures of the flow. Improved understanding and forecasting requires novel notions and techniques capable of casting light on why material is transported the way it is by a given flow. The goal of this course is acquaint the student with a series of recent developments originated at the interface of nonlinear dynamics and fluid dynamics that have led to a number of novel such notions and techniques.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 720. Marine Physical Chemistry. 3 Credit Hours.
Physical-chemical principles applied to the marine environment, based on thermodynamics and the study of rate processes.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 721. Waves and Tides I. 3 Credit Hours.
The focus of this course is on the kinematics, dynamics and energetics of wave motions in the ocean and atmosphere from both theoretical and observational perspectives. We examine the internal wave spectrum ranging from the buoyancy frequency to the inertial frequency including the WKBJ scaling of the momentum by the buoyancy frequency. The IW spectrum often contains both the semidiurnal and diurnal tidal frequencies where the former is often referred to as internal tide that are excited along continental margins by barotropic tides. Within the context of normal modes, Kelvin and topographically Rossby waves are also present in this regime known as coastally trapped (also known as continental shelf waves). The course then goes into the equatorial wave guide that supports these motions (except for near-inertial motions). This is followed by the forced wave motions by atmospheric fronts and cyclones where Green’s functions are introduced to derive analytical expressions for the 3-D current structure.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 724. Statistical Modeling of Geophysical Fields. 3 Credit Hours.
An advanced course in statistical modeling, analysis, and assimilation of geophysical data. Emphasis is placed on practical applications, computer software, and new nonstandard techniques.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 731. Air-Sea Interaction. 3 Credit Hours.
Oceanic and atmospheric mixed layers including fluxes of heat, momentum, moisture and salt between the ocean and atmosphere; vertical distribution of energy sources and sinks at the interface including the importance of surface currents; forced upper ocean dynamics, the role of surface waves on the air-sea exchange processes and ocean mixed layer processes.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 735. Life in Moving Fluids. 3 Credit Hours.
The physical characteristics of fluids are described and quantified in relation to various flow phenomena that play a part in life functions. Adaptations of forms and functions reflect the different properties of the media. Energy conversion and transfer limit form and function and enable a wide variety of survival strategies. This course is mainly about the adaptation of marine organisms to moving fluids, small scale movement ecology, and diversity in physical constraints and adaptation in marine ecosystem.
Prerequisite: OCE 701.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 736. Modeling of Physical-Biological Interactions. 3 Credit Hours.
The course is designed to teach students the basics components for building coupled physical biological models. Students will be able to understand the processes affecting from low- to high-trophic level organisms in the planktonic environment. Emphasis will be given on numerical simulations of mechanisms involved in: Plankton distribution and patchiness; Trophic interactions (NPZD); Larval behavior and transport; Marine population connectivity.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 750. Coastal Ocean Circulation. 3 Credit Hours.
The oceanography of the continental margins are where tides, winds and waves interact on a spectrum of temporal and spatial scales in driving the shelf circulation from the shelf break to the inner shelf. The effects of baroclinicity, topography (and bottom stresses) will be explored in this course. We will highlight fundamental differences between wide versus narrow shelves, and those where boundary currents impact the shelf circulation such as the Loop Current on the west Florida shelf; Florida Current and Gulf Stream along the east coast; and the weaker and broader California Current along the US west coast.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 752. Vortex Dynamics. 3 Credit Hours.
This course will cover fundamental to advanced topics in vortex dynamics. A review of fluid dynamics and vorticity in two dimensions will be followed by studies of vortex dynamics in three-dimensional, incompressible flow and in three-dimensional, stratified flow.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 762. Computer Models in Fluid Dynamics. 3 Credit Hours.
Course topics include numerical techniques of dealing with dynamic problems in meteorology and oceanography. Dynamic prediction models, initial data conditioning, computational stability, and error estimates are also included.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 763. Environmental Photochemistry. 3 Credit Hours.
Introduction to the principles of photochemistry and their application to understanding sunlight initiated processes in the region of the ocean-atmosphere interface. Organic and inorganic photochemical reactions and subsequent thermal reactions in solution, gas, and solid media are discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 764. Atmospheric and Oceanic Turbulence. 3 Credit Hours.
Structure and dynamics of planetary boundary layers, turbulent transport processes, Fickian and statistical theories of turbulence, influence of stratification, and rotation on turbulent motion are discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 767. Spectral and Finite Element Methods in Computational Fluid Dynamics. 3 Credit Hours.
The simulation of fluid flows in geometrically complex domains (like ocean basins) and/or with high fidelity requires the adoption of new discretization techniques that can simultaneously handle the complicated geometry and permit high accuracy solution. The finite element method has traditionally been used to tackle the geometric complexity while spectral methods have been developed to handle high accuracy in simple geometries. Here we present an approach to handle both complexity within a single framework, namely the spectral element method. The course starts by describing the weak formulation common to all finite element methods which, by design, are geometrically flexible. The second part of the course describe how high order polynomial can be implemented within the finite element framework to achieve high accuracy rates.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 768. Marine Trace Element Geochemistry. 3 Credit Hours.
This course includes an in-depth discussion on all major aspects of oceanic trace element cycle and their application in oceanography and climate studies. The discussed topics include distribution, controlling processes, trace element speciation, isotopes, the role of trace elements in oceanic cycle of major nutrients and the application in the studies of past ocean history and climate. New data and major findings of the on-going GEOTRACES program will also be discussed.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 770. Seminar in Ocean Sciences. 1 Credit Hour.
Oral presentation of research and special topics by students, faculty, and visiting scientists.
Components: SEM.
Grading: SUS.
Typically Offered: Fall & Spring.

OCE 772. Advanced Underwater Acoustics. 3 Credit Hours.
Analysis and numerical modeling of sound propagation in the ocean: geometrical acoustics, normal mode theory, and the parabolic equation method. Recent advances in underwater acoustics: effects of oceanic variability, signal fluctuations, random medium propagation, ocean bottom interactions, and shallow water propagation are also examined.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 776. Mesoscale Oceanography. 3 Credit Hours.
The course will present a current view of our understanding of ocean mesoscale variability, including its properties in different oceanic regimes, the dynamics governing its origin and development, and its overall role in the oceans and climate. Lectures will present material covering theory, observations (both in situ and satellite), and numerical model results. Students will learn basic concepts on ocean mesoscale processes and perspectives on current research topics from lectures, assignments and research papers.
Components: LEC.
Grading: GRD.
Typically Offered: Fall.

OCE 780. Capstone Independent Study of Coastal Engineering (MSOE). 3 Credit Hours.
OCE 780 is an independent study course in the field of Coastal Engineering that is intended to be a final semester capstone project in the MS in Ocean Engineering program. The student will work with the instructor to select a laboratory or field experimental project of interest related to coastal oceanographic engineering. The student will review the background of similar studies, design the project applying appropriate scaling laws (in the case of the laboratory studies), design the measurements to be taken and the protocols for doing so. The student will assist in model construction as required. Data will be collected, analyzed and archived. A report will be prepared and presented at an open seminar on campus.
Components: IND.
Grading: GRD.
Typically Offered: Fall, Spring, & Summer.

OCE 786. Advanced Ocean Measurements. 2 Credit Hours.
Theory and techniques of ocean measurements, ocean data systems, and processing and ocean data transmission are discussed. Lecture, 2 hours.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 790. Mechanics and Thermodynamics of the Air-Sea Interface. 3 Credit Hours.
This course deals with the theory and practice of air-sea interaction. Two hours of lectures and one hour in the wind-wave laboratory provide an appropriate mix of theory and experiment. The topics covered include: thermodynamics of the interface; conservation equations; wave generation, propagation, and dissipation; boundary layer turbulence; heat, mass, and momentum transfer; energy dissipation, intermittency; turbulence closure; and wave prediction models.
Components: LEC.
Grading: GRD.
Typically Offered: Spring.

OCE 795. Advanced Studies. 1-3 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: SEM.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 798. Advanced Studies. 1-3 Credit Hours.
Supervised study in areas of special interest to graduate students.
Components: LEC.
Grading: GRD.
Typically Offered: Offered by Announcement Only.

OCE 805. MPS Internship. 1-6 Credit Hours.
The Master of Professional Science internship is an approved, supervised internship project with an organization engaged in activities associated with the student’s degree track. The internship results in a collaborative project, written report, and oral presentation on a topic approved by the student’s advisory committee. Up to 6 credits are necessary for graduation
Components: PRA.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

OCE 810. Master’s Thesis. 1-6 Credit Hours.
The student working on their master’s thesis enrolls for credit, in most departments not to exceed six, as determined by their advisor. Credit is not awarded until the thesis has been accepted.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

OCE 820. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the master’s degree, after the student has enrolled for the permissible cumulative total in appropriate thesis research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

OCE 830. Doctoral Dissertation. 1-12 Credit Hours.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by their advisor, but for not less than a total of 12 hours. Up to 12 hours may be taken in a regular semester, but not more than six in a summer session. Where a student has passed their (a) qualifying examinations, and (b) is engaged in an assistantship, they may still take the maximum allowable credit stated above.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.

OCE 850. Research in Residence. 1 Credit Hour.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.
Components: THI.
Grading: SUS.
Typically Offered: Fall, Spring, & Summer.