

# OCNG - OCEANOGRAPHY

## OCNG 600 Survey of Oceanography

**Credits 3. 3 Lecture Hours.** General survey of the scientific framework of oceanographic study; applications of ocean research to social and economic problems; interrelations between the ocean disciplines and other fields of study. **Prerequisite:** Approval of instructor.

## OCNG 603 Communicating Ocean Science

**Credits 3. 3 Lecture Hours.** Instruction and practice with presenting scientific information on the ocean to a variety of audiences under different time constraints; critical components for any presentation; knowing your audience; designing effective visual aids and graphics; leading your audience through complex concepts; and communication with non-scientists; also taught at Galveston campus.

## OCNG 604 Ocean Observing Systems

**Credits 3. 3 Other Hours.** Investigate the rationale behind ocean observing systems; familiarize with the relevant social, scientific design, technology, and policy issues associated with observing systems. **Prerequisite:** Approval of instructor.

## OCNG 605 Oceanography Cruise

**Credits 2. 2 Other Hours.** Specialized experience in research methods and analysis in oceanography via preparation for and participation in a research cruise of at least two weeks duration under the supervision of a Texas A&M oceanography faculty member. May be taken up to two times for MS candidates and four times for PhD candidates. **Prerequisite:** Approval of instructor.

## OCNG 608 Physical Oceanography

**Credits 3. 3 Lecture Hours.** Observations, instruments; physical properties of seawater; property distributions; characteristics of water masses; heat budget; kinematics; gravity, pressure, hydrostatics, stability; horizontal flow; Coriolis force, geostrophy; friction, wind drift; general circulation; wave motions; tides. **Prerequisites:** MATH 152 and PHYS 208, or equivalents.

## OCNG 609 Dynamical Oceanography

**Credits 3. 3 Lecture Hours.** Systematic treatment of the kinematics, dynamics and thermodynamics of the ocean; integral conservation relations; solenoidal versus conservative vector fields; potential vorticity; geostrophic adjustment; inertial and buoyancy modes; Bernoulli-Montgomery potential; energetics in a rotating system; available potential energy; natural temporal and spatial scales. **Prerequisites:** OCNG 608 or ATMO 435; MATH 601.

## OCNG 610 Mathematical Modeling of Marine Ecosystems

**Credits 4. 3 Lecture Hours. 2 Lab Hours.** Theory and technique of model development for marine ecosystems; mathematical representation of interactions among nutrients, phytoplankton, zooplankton, fish and the physical environment; scrutiny of biological concepts and mathematical structure of existing models; laboratory segment to focus on computational techniques applicable to classroom problems. **Prerequisites:** OCNG 608 and OCNG 620, calculus or approval of instructor.

## OCNG 611 Global Scale Oceanography

**Credits 3. 3 Lecture Hours.** A balanced description of the ocean's large-scale circulation and water mass structure based on the interpretation of modern observations, with emphasis on the ocean's role in global climate, and physical-chemical property fluxes in basin to global scale budgets.

## OCNG 613 Polar Regions of the Earth: Science, Society, and Discovery

**Credits 3. 3 Lecture Hours.** Disciplines and topics that define modern polar science in the north and south; includes history of the Polar Regions, polar geosciences, major polar scientific projects, and special topics; participate as individuals and teams in education, outreach and science projects. **Prerequisite:** Graduate classification.

## OCNG 616 Numerical Modeling of Ocean Circulation

**Credits 4. 3 Lecture Hours. 2 Lab Hours.** Quasigeostrophic ocean circulation models; Arakawa's energy and enstrophy conserving scheme; spectral barotropic vorticity model on sphere; shallow water primitive equation models; geostrophic adjustment on different numerical grids; boundary conditions in numerical models; introduction to ocean general circulation models; mixed models and sub-gridscale parameterization; oceanic data assimilation. **Prerequisite:** OCNG 618.

## OCNG 617 Theories of Ocean Circulation

**Credits 3. 3 Lecture Hours.** Theories of wind-driven circulation, Sverdrup solution, frictional and inertial boundary regimes; instabilities, meanders and mesoscale features; role of stratification, topography and time dependence; Thermohaline circulation. **Prerequisite:** Graduate classification.

## OCNG 618 Numerical Methods for the Geosciences

**Credits 3. 3 Lecture Hours.** Mathematical theory and numerical techniques for modeling physical systems and processes in the Geosciences; discretization of continuum equations for solids and fluids; finite difference methods, convergence, consistency, and stability; finite element and spectral methods in fluid dynamics and seismology; iterative solvers; implicit and explicit methods for diffusion and advection. **Prerequisite:** Graduate classification or approval of instructor. **Cross Listing:** ATMO 618 and GEOP 618.

## OCNG 620 Biological Oceanography

**Credits 3. 3 Lecture Hours.** Critical analysis of contribution of biological science to our understanding of sea; discernible interrelationships between organisms and physicochemical parameters. **Prerequisites:** General prerequisites for oceanography.

## OCNG 624 Machine Learning in Environmental Sciences

**Credits 3. 3 Lecture Hours.** Core coding techniques; read and write real data using standard formats; scientific programming; analysis of environmental data sets; visualizing environmental data; geospatial data analysis; applied machine learning. **Prerequisites:** Graduate classification.

## OCNG 625 Current Topics in Biological Oceanography

**Credit 1. 1 Lecture Hour.** Areas of current research; plankton processes; microbial food web; benthic communities; fisheries; global change. May be taken up to three times. **Prerequisite:** OCNG 620 or approval of instructor.

## OCNG 626 Ocean Pollution

**Credits 3. 3 Lecture Hours.** Fundamental concepts of ocean pollution; major groups and chemical structures of marine pollutants; toxicity mechanisms; environmental impact assessment of pollutants in marine ecosystems. **Prerequisites:** OCNG 640, or approval of instructor.

## OCNG 627 Ecology of the Continental Shelf

**Credits 3. 3 Lecture Hours.** Environments, populations and communities of the continental shelf. Interactions of the shelf with the estuaries and the deep sea; man's impact on the shelf ecosystems. **Prerequisite:** Approval of instructor.

## OCNG 630 Geological Oceanography

**Credits 3. 3 Lecture Hours.** Survey of marine geology, structure and composition of ocean basins and continental margins, properties of marine sediments. **Prerequisites:** General prerequisites for oceanography.

## OCNG 632 Sea-Level Change

**Credits 3. 3 Lecture Hours.** Modern sea level; topography, measurement, meteorologic and oceanographic contributions, periodic and non-periodic changes; long-term changes: determination, Cenozoic history, Quaternary glacial-interglacial fluctuations; changes during the past century and decade; observations, natural and anthropogenic influences; estimates of future changes and societal implications. **Prerequisite:** Graduate classification; approval of instructor.

## OCNG 640 Chemical Oceanography

**Credits 3. 3 Lecture Hours.** Chemical composition and properties of seawater, evaluation of salinity, pH, excess base and carbon dioxide in sea. Marine nutrients, oxygen and other dissolved gases, organic constituents. **Prerequisites:** General prerequisites for oceanography.

## OCNG 641 Inorganic Aquatic Geochemistry

**Credits 3. 3 Lecture Hours.** Chemical composition and properties of waters in the near Earth surface environment and their interactions with sedimentary minerals; major topics: thermochemical properties of natural waters, equilibrium and kinetic controlling ion speciation; geochemical processes at mineral surfaces; kinetics of mineral-water interactions; applications to modeling early diagenesis. **Prerequisite:** Approval of instructor.

## OCNG 644 Isotope Geochemistry

**Credits 3. 3 Lecture Hours.** Stable and radioactive isotope variations in natural materials; applications to geochronometric, geothermometric and paleoclimatologic studies of the marine environment. **Prerequisite:** Approval of instructor; also taught at Galveston campus.

## OCNG 645 Marine Organic Biogeochemistry

**Credits 3. 3 Lecture Hours.** Origins, fates and distribution of organic compounds in contemporary marine environments and in recent and ancient sediments; specific analytical techniques. **Prerequisite:** General chemistry.

## OCNG 646 Dynamics of Colloids in the Environment

**Credits 3. 3 Lecture Hours.** Equilibrium and dynamic aspects of the physics and chemistry of such colloidal particles and macromolecules and the implications for environmental systems, relevant for organic carbon flux and cycling, fate and transport of pollutants, bioavailability of pollutants, or mobility of pollutants in groundwater. **Prerequisites:** Physical Chemistry, Thermodynamics, Aquatic and Organic Chemistry; also taught at Galveston campus.

## OCNG 650 Aquatic Microbial Ecology

**Credits 3. 3 Lecture Hours.** Microbes in natural environments, including both water and sediment habitats in marine, fresh and ground water systems; process studies of microbial foodwebs and biogeochemical cycling; current methods and research directions. **Prerequisites:** OCNG 620 and WFSC 414 or approval of instructor.

## OCNG 651/ATMO 651 Dynamics of Ocean-Atmosphere Interaction

**Credits 3. 3 Lecture Hours.** Major features of the atmosphere and ocean; interaction between the two systems; coupled modes of variability in ocean-atmosphere system; dynamics of El Niño-Southern Oscillation and related phenomena in the tropics; extratropical ocean-atmosphere feedbacks. **Prerequisite:** OCNG 608 or ATMO 601. **Cross Listing:** ATMO 651/OCNG 651.

## OCNG 652 Sedimentary Biogeochemistry

**Credits 3. 3 Lecture Hours.** An interdisciplinary approach to understanding complex processes that occur near the marine sediment-water interface in marine and estuarine environments. Composition of marine sediments, pore water chemistry, role of organisms in chemical transformations and pelagic-benthic coupling. Carbon, nitrogen and sulfur cycling in sediments. Modeling biogeochemical processes at the sediment-water interface and during early burial diagenesis. **Prerequisites:** OCNG 620 and OCNG 640 or approval of instructor.

## OCNG 654 Plankton Ecology

**Credits 3. 2 Lecture Hours. 2 Lab Hours.** Elective course, overview of phytoplankton and zooplankton; taxonomy; physiology; ecology; sampling design; current methods of investigation. **Prerequisite:** OCNG 620.

## OCNG 655 Experimental Design and Analysis in Oceanography

**Credits 3. 3 Lecture Hours.** Elements of experimental design in oceanography; logistics of data collection; critical evaluation of field sampling strategies; formulation of field studies suitable for hypothesis-based inquires using the standard linear regression mode; analysis of variance and principal component analysis. **Prerequisite:** Approval of instructor.

## OCNG 656 MATLAB Programming for Ocean Sciences

**Credits 3. 2 Lecture Hours. 2 Lab Hours.** Computation techniques for oceanographic data processing using MATLAB; focus on the analysis of oceanographic-related data sets and real-world oceanographic applications; individual data sets analyzed. **Prerequisite:** Graduate classification.

## OCNG 657 Data Methods and Graphical Representation in Oceanography

**Credits 3. 3 Lecture Hours.** Application of advanced statistical, quantitative and computational methods to oceanographic observational data; methodologies emphasized include spectral analysis and representations of time series data, optimal interpolation of irregular data fields, analysis of multiple variables using Empirical Orthogonal Functions and scientific interpretation of statistical quantities. **Prerequisite:** Approval of instructor.

## OCNG 659 Ocean Observing Applications

**Credits 3. 3 Lecture Hours.** Conceptualization, design, and construction of oceanographic observing systems; practical experience with the Texas Automated Buoy System including system design, instrumentation setup and calibration, telecommunication systems, and data management. **Prerequisites:** Master or doctoral classification in OCNG or related field by approval of instructor.

## OCNG 661 Advanced Oceanographic Data Analysis and Communication

**Credits 3. 3 Lecture Hours.** Project design and planning for oceanographers; oceanographic data organization and analysis; synthesis and interpretation of data analysis; technical report writing and presentation. **Prerequisite:** OCNG 604, OCNG 608 and OCNG 657, or approval of instructor.

## OCNG 662 Coastal and Marine Sedimentary Processes

**Credits 4. 3 Lecture Hours. 2 Lab Hours.** Sedimentary processes (erosion, transport and deposition) from the coastline to the deep sea; development of estuaries, deltas, continental shelves, submarine canyons, fans; behavior of fluids and particles in boundary layers. Lab: recirculating flume, field and lab instrumentation. **Prerequisite:** Approval of instructor.

## OCNG 669 Python for Geosciences

**Credits 3. 3 Lecture Hours.** Core language Python programming; scientific programing analysis methods; analysis of large geophysical data sets; plotting geophysical data; interpolation. **Prerequisite:** Graduate classification.

## OCNG 670 Deep Sea Sediments

**Credits 3. 3 Lecture Hours. 0 Lab Hours.** Formation process, core description, physical properties, lithostratigraphy, seismic stratigraphy and paleoceanographic significance of deep marine sediments.

## OCNG 673 High-Resolution Marine Geophysics

**Credits 3. 2 Lecture Hours. 2 Lab Hours.** Introduction to the geophysical nature of the seafloor and marine subbottom to 1.5 seconds two-way travel time; generation, use and interpretation of reflection and side-scan sonar records and magnetic anomalies of various marine environments and seafloor features. **Prerequisite:** Approval of instructor.

## OCNG 674 Paleoceanography

**Credits 3. 3 Lecture Hours.** History of oceans through geologic time; marine paleontological, geochemical, sedimentological and geophysical evidence; inferred changes in seawater properties, ocean circulation and sea level; relation to climate, tectonic processes, atmospheric chemistry and evolution of life. **Prerequisite:** OCNG 630 or approval of instructor.

## OCNG 677/ATMO 677 Geophysical Data Assimilation

**Credits 3. 3 Lecture Hours. 0 Lab Hours.** Modern data assimilation methods applied to oceanic and atmospheric circulation models, as well as in other simple models; methods to interpolate one-, two- and three-dimensional randomly spaced data to regular grids for use in numerical models of atmospheric and oceanic circulation. **Prerequisites:** OCNG 669. **Cross Listing:** ATMO 677/OCNG 677.

## OCNG 678 Coastal Dynamics

**Credits 3. 3 Lecture Hours.** Surveys dynamical processes that determine estuarine and continental shelf circulation; geophysical scale flow where Earth's rotation and buoyancy effects are important; analytical and numerical methods used to isolate and study these processes. **Prerequisite:** OCNG 609.

## OCNG 679 Proxy Reconstruction of Late Cenozoic Climate: Calibrations and Applications

**Credits 3. 3 Lecture Hours.** Paleo-proxy calibration and application in reconstructing Late Cenozoic climate history; issues related to geochemical and sedimentological proxies used in the field of paleoclimatology/ paleoceanography. **Prerequisite:** Graduate classification.

## OCNG 680 Paleoclimate

**Credits 3. 3 Lecture Hours.** Overview of climate change in the geological past; reconstructing past climates; causes of past climates and climate change; climate change in the Cenozoic; extreme climates. **Prerequisite:** Approval of instructor.

## OCNG 681 Seminar

**Credit 1. 1 Lecture Hour.** Presented by faculty, students, staff and visiting scientists; based on recent scientific research.

## OCNG 684 Professional Internship

**Credits 1 to 6. 1 to 6 Other Hours.** A directed internship in a professional setting to provide on-the-job training in ocean observing systems skills appropriate to the student's professional objectives. **Prerequisites:** Approval of student's committee chair.

## **OCNG 685 Directed Studies**

**Credits 1 to 6. 1 to 6 Other Hours.** Special topics to suit small group requirements. Problems not within thesis research and not covered by any other course in established curriculum. **Prerequisites:** General prerequisites for oceanography; also taught at Galveston campus.

## **OCNG 689 Special Topics in...**

**Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.** Selected topics in an identified area of oceanography. May be repeated for credit. **Prerequisite:** Approval of instructor.

## **OCNG 691 Research**

**Credits 1 to 23. 1 to 23 Other Hours.** For thesis or dissertation; also taught at Galveston campus.