**MARINE SCIENCE (MARS)**

### MARS 500 | CORE SEMINAR I
**Units:** 2

An introduction to the infrastructure of the Marine Science graduate program and to those critical skills useful in graduate studies. Students will be exposed to a range of research areas through a series of seminars presented by the Marine Science faculty, allied university faculty in other departments and scientists from other institutions. Students also will choose a thesis committee chair and develop a written preliminary plan for their own research in pursuit of the master’s degree.

### MARS 510 | OCEANOGRAPHY I: GEOLOGICAL OCEANOGRAPHY
**Units:** 4

The origin and geologic history of the ocean basins, with a detailed investigation of the theory of plate tectonics, ocean sedimentation and paleoceanography. Examination of how geological processes affect physical, chemical and biological processes in the ocean will be emphasized. Students will present and discuss primary literature pertinent to the topics covered in the course. Three lectures and one laboratory per week. One cruise and one additional weekend field trip may be required. Prerequisite: a course in introductory geology, with laboratory, is recommended.

### MARS 511 | OCEANOGRAPHY II: BIOLOGICAL OCEANOGRAPHY
**Units:** 4

Biological oceanography is covered from an integrated, functional perspective. Unifying themes will be factors that affect marine ecosystems and the relationship between environmental characteristics and biological communities. Nearshore, open ocean and deep sea environments will be covered. Ecological, behavioral, physiological and biochemical adaptations of marine organisms also will be considered. Primary literature, scientific writing and experimental design will be emphasized. Three lectures and one laboratory per week. One cruise and additional fieldwork may be required. Prerequisite: one year of general biology, with laboratory.

### MARS 512 | OCEANOGRAPHY III: MARINE GEOCHEMISTRY
**Units:** 4

Why are the oceans salty? This course begins by tracing the path of material sources to the ocean reservoir; from river, groundwater, atmospheric and hydrothermal vent pathways. A significant emphasis is placed on chemical processes operating within the ocean reservoir, such as carbonate equilibrium, trace element distributions in sea water and particulate matter reactivity. The course concludes with an analysis of geochemical processes occurring within material sinks in the oceans, which are largely controlled by sediment redox and diagenetic processes. Three lectures and one laboratory per week.

### MARS 513 | OCEANOGRAPHY IV: MARINE COMMUNITY ECOLOGY
**Units:** 4

This course is intended to introduce students to the fundamentals of marine community ecology, provide students with field experiences so that they may become familiar with various ecological sampling designs and methods and expose students to the diversity of coastal marine environments in the San Diego area. Students will read and discuss classic marine ecology papers and conduct marine ecological studies in field and laboratory settings. Students will also be required to participate in a semesterlong research project.

### MARS 520 | STATISTICS
**Units:** 3

This course is intended to build on a basic understanding of statistical analysis gained at the undergraduate level. The course will review methods of hypothesis testing and the statistical tests most commonly used in oceanography. It will introduce multivariate techniques and modern nonparametric methods. The main emphasis will be experimental design and choosing the most appropriate methods of statistical analysis to answer specific questions. Students will learn how to use the statistical software package R and will have the opportunity to work with their own data, if applicable. Three hours per week. Prerequisite: an undergraduate course in statistics or consent of instructor.

### MARS 552 | ELECTRON MICROSCOPY
**Units:** 4

An introduction to the theory, development and operation of the electron microscope with emphasis on development of knowledge of cellular fine structure. The laboratory portion of the course will focus on tissue preparation, microscope operation and evaluation and presentation of electron microscopic data.

### MARS 562 | BIOLOGY OF FISHES
**Units:** 4

Prerequisites: BIOL 300

Course examines the various aspects of ichthyology encompassing the anatomy, physiology, ecology, evolution, ethology and natural history of fishes. Lab includes techniques of identification and a general survey of fish systematics and zoogeography. Three hours of lecture and one laboratory per week.

### MARS 565 | MARINE MAMMALS
**Units:** 3

An examination of the biology of whales, pinnipeds and other marine mammals. Topics will include general adaptations to a marine existence; systematics and biogeography; reproduction; diving physiology; communication and echolocation; feeding and migratory behavior; and marine mammal-human interactions. Some emphasis will be placed on species occurring in the North Pacific Ocean. Necropsies of a beach-stranded marine mammal may occur. Special projects will also be assigned. Three hours of lecture per week. Prerequisites: one year of introductory biology and at least two upper-division courses in zoology or ecology, or consent of instructor.

### MARS 567 | DEEP SEA BIOLOGY
**Units:** 3

This course explores the biology of organisms inhabiting the deep ocean, especially as their biology is influenced by the environment in which they live. Topics will include the physical, chemical and geological setting; instrumentation used in deep-sea research; the systematics and ecology of deep-sea fauna; physiological and biochemical adaptations to the conditions in the deep ocean; and impacts of humans on the deep-sea environment. Three hours of lecture per week. Prerequisites: one year of introductory biology and at least two upper-division courses in ecology or zoology, or consent of instructor.

### MARS 573 | CLIMATOLOGY
**Units:** 4

Prerequisites: BIOL 300 with a minimum grade of C-

A course to cover principles of climatology and methods of climatic data analysis. The fundamentals of climatology, methods and technologies used in acquiring and analyzing climatic data and current issues such as human-induced climatic changes will be discussed. This course will cover the Earth’s energy budget and temperature, moisture in the atmosphere and precipitation, winds and the general circulation and climates in different regions of the world. Three lectures and one laboratory per week. Prerequisites: a course in meteorology or earth science and a course in statistics, or consent of instructor.
MARS 574 | HISTORY OF THE EARTH AND CLIMATE
Units: 3
Prerequisites: MARS 510 with a minimum grade of C- or MARS 512 with a minimum grade of C-
A survey of the history of the earth system focusing on ocean-atmosphere-ice sheet dynamics and their interaction on past global climate change. Topics include geologic record of past climate cycles, causal mechanisms of past climate change and the scientific basis of global warming. Three hours of lecture per week.

MARS 574L | HISTORY OF THE EARTH AND CLIMATE LABORATORY
Units: 1
Prerequisites: MARS 510 with a minimum grade of C- or MARS 512 with a minimum grade of C-
A laboratory course designed to introduce students to methods and techniques used in historical geology and paleoclimatology including: a) identification of depositional environments; b) identification of invertebrate fossils and modes of fossilization; c) correlation and sequence stratigraphy; d) radiometric dating; and e) isotopic proxies of climate. The laboratory may include field trips.

MARS 585 | ENVIRONMENTAL GEOLOGY
Units: 4
This course will provide an in-depth examination of the geological principles and issues pertinent to the environmental consulting industry. It will include a discussion of geologic hazards, including floods, mass wasting, earthquakes and erosion. An examination of the geology of groundwater occurrence, groundwater flow and groundwater development and management also will be addressed. Specific examples from the San Diego region will be emphasized. Three lectures and one laboratory per week. Prerequisite: a course in introductory geology, with laboratory, or consent of instructor.

MARS 587 | SURFACE WATER HYDROLOGY
Units: 4
A course to cover principles of surface water hydrology and methods to solve hydrologic problems related to urbanization, soil and water conservation and water resources management. The components of the hydrologic cycle and the concept of water balance will be discussed in detail. This course also will cover various methods of hydrologic computation, the basics of watershed modeling, applications of GIS in hydrology and issues especially relevant to Southern California. Three lectures and one laboratory per week and some field trips. Prerequisites: a course in introductory geology, with laboratory, or consent of instructor. An introductory course in statistics is recommended.

MARS 594 | SPECIAL TOPICS
Units: 2-4
Topics of special interest or unique opportunity. Prerequisites may be listed for these offerings.

MARS 595 | DIRECTED READINGS
Units: 1-3
Specific sets of readings tailored to address particular needs of a student. Generally, this course would be related to the research interests of a student and would be under the guidance of a member of the student’s thesis committee. Typically, a maximum of three units may be used toward the degree requirements without consent of the director.

MARS 596 | RESEARCH
Units: 0.5-6 Repeatability: Yes (Can be repeated for Credit)
Research toward the master’s thesis. This research will be under the general supervision of a thesis advisor. No more than three units may be taken prior to candidacy. Pass/Fail only. A passing grade is contingent upon participation in the annual Graduate Student Colloquium during the same academic year.

MARS 597 | THESIS
Units: 0.5-1 Repeatability: Yes (Can be repeated for Credit)
Independent writing of the thesis with consultation of the major advisor. Master’s candidates must be enrolled in this course to turn in a thesis. It may be taken more than once, but only 1 unit will be counted toward the degree requirements.