Las Positas College
3000 Campus Hill Drive
Livermore, CA 94551-7650
(925) 424-1000
(925) 443-0742 (Fax)

Course Outline for GEOL 12

INTRODUCTION TO OCEANOGRAPHY

Effective: Fall 2017

I. CATALOG DESCRIPTION:
GEOL 12 — INTRODUCTION TO OCEANOGRAPHY — 3.00 units

Introduction to the oceans, the history of oceanic science, instrumentation and exploration; marine geology including plate tectonics and shoreline processes; physical and chemical properties of sea water; causes and effects of currents, tides, and waves; introduction to the basic types of marine life, the basic marine habitats and ecosystems; distribution of marine resources and the Law of the Sea.

3.00 Units Lecture

Grading Methods:
Letter or P/NP

Discipline:

	MIN
Lecture Hours:	54.00
Total Hours:	54.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. explain the scientific method; and to be able to differentiate facts from theories;
B. discuss and explain the history of oceanic science, instrumentation and exploration;
C. recognize basic marine geography and identify the location of the oceans and major seas of the world and their relative areas;
D. explain and discuss the common theories regarding the formation of the Earth, its atmosphere, oceans and internal layers;
E. explain, discuss, analyze, identify and/or interpret the basics of Marine Geology, including the geology of both global and marine plate tectonic environments, marine geomorphology, sea floor, island and coastal geology; including beaches, reefs, bays, and estuaries
F. explain, discuss, analyze, identify and/or interpret the basics of Seawater Chemistry and Physics, including the basic properties of seawater;basic atmospheric circulation and how that drives major oceanic currents; oceanic circulation/currents; and waves, tides and tsunamis
G. explain, discuss, analyze, identify and/or interpret the basics of Marine Life and Marine Life Habitats
H. explain, discuss, analyze, identify and/or interpret the basics of Environmental Oceanography and the Law of the Sea

V. CONTENT:
A. Introduction
    1. The History of Oceanic Science
        a. Exploration and discovery of the Oceans.
        b. Oceanic instrumentation; history and development
    2. Geography and Basic Facts of the oceans and seas
        a. Areal % of globe
        b. Major oceans and seas
        c. Depth; maximum and average
    3. Basic Oceanic Units and Systems
B. Formation of the Earth and the Universe
    1. Concept of Theory vs. Fact
    2. The Scientific Method
    3. The Big Bang
    4. The formation of the Solar System
    5. The formation of the Earth's
        a. Early crust, continents and ocean floors
        b. Early mantle and core
        c. Lithosphere and asthenosphere
        d. Early atmosphere
        e. Early oceans (where did the water come from?)
        f. How did seawater become salty?
C. Plate Tectonics
    1. Evidence for and evolution of Plate Tectonic Theory

a. Evidence for Continental Drift
b. Ocean Floor evidence & discoveries
c. Sea Floor Spreading

2. Impact of Plate Tectonic Theory to the fundamentals of global geologic interpretations
    a. Three Types of Plate Edges and their geologic features: volcanoes, earthquakes, etc.
        1. Convergent
        2. Divergent
        3. Transform
    b. Hot Spots
    c. Theories of Driving Mechanisms for Plate Tectonics
    d. Mantle Convection, etc.
    e. Supercontinents and Plate Tectonic reconstructions

D. Marine Geomorphology and Geology
1. Mid-Oceanic Ridge system
    a. Fracture zones
2. Trenches
3. Continental Shelf, Slope, Rise and Abyssal Plain
    a. Turbidites
    b. Graded bedding
4. Submarine Canyons
5. Seamounts and Guyots
6. Aseismic Ridges; including the 90 East Ridge

E. Sea Floor Geology
1. Oceanic Crust
    a. Four Basic Layers
        1. Marine sediments
        2. Pillow basalts
        3. Sheeted dikes
        4. Gabbros
        5. Obduction and ophiolites
        6. Genesis and formation of the four major layers at the MOR
    b. Hydrothermal Vents
        1. Mineral composition and geologic formation
        2. Marine life communities and chemosynthesis
        3. Applications to theories of the formation of life on earth
2. Seismic Reflection and Refraction
3. Seamounts, Guyots and Oceanic Volcanoes

F. Marine Sediments
1. Clastics (lithogenic/terrigenous)
2. Biogenic (biogenous)
    a. Oozes; calcareous and siliceous
    b. Oil and gas formation and probable locations
    c. Microplankton
    d. Limestone
    e. Chert
3. Precipitated (hydrogenous)
    a. Manganese nodules
    b. Black smoker chimney sulfides
    c. Evaporites
    d. Carbonates; including Tufa Towers
    e. Chert
    f. Phosphorous Nodules
    g. Glauconite Green Sands
4. Cosmic (cosmogenous) = meteorites
5. Continental Margin vs. Deep Sea Sediments and Sedimentation Processes
6. Carbonates
    a. Origin; biological or precipitated
    b. Coral Reefs
        1. Basic types of coral reefs
            a. Fringing reefs
            b. Barrier reefs (including the Great Barrier Reef)
            c. Atolls
    c. The Calcium Carbonate Compensation Depth
        1. Deposition of limestone on the ocean floor

G. Shoreline Geology
1. Wave Erosion
    a. Refraction
    b. Sea cliff retreat
    c. Wave base and wave-cut terraces and marine terraces
2. Beaches
    a. Origin and genesis of different types of beach sand
    b. Longshore transport
    c. Groins, jetties and breakwaters
    d. Beach engineering
        1. Case study: Santa Barbara
    e. Spits, baymouth bars, tombolos, barrier islands
3. Comparison of coastlines
    a. Atlantic and Pacific Coastlines
    b. Emergent and submergent coastlines
    c. Active and passive plate tectonic margins and coastlines
4. Estuaries, Bays and Salinity
    a. Estuarine circulation and stratification
    b. Mediterranean circulation
5. Deltas
6. Wetlands

H. Seawater Physics and Chemistry & The Effects on Marine Life
1. The Water Molecule
    a. Polarization
    b. Surface tension
    c. Universal Solvent

2. Density of Water compared to air 800:1
3. Heat Capacity
    a. Onshore and Offshore Breezes
4. Water Density Anomaly
    a. Ice Floats
    b. Density of Ice = 90% Density of Liquid Water
5. Light & Color
    a. Reflection
    b. Absorption
    c. Color of ocean and productivity and content of the water
        1. Red tides
    d. Light zones: euphotic, disphotic, aphotic
    e. Provinces
        1. Neritic
        2. Oceanic
            a. Epipelagic
            b. Mesopelagic
            c. Deep scattering layer
            d. Bioluminescence
            e. Eye sensitivity
            f. Abyssopelagic, bathypelagic and hadal zones
            g. Productivity
            h. Type of life and adaptations
    f. Refraction
6. Temperature & Density
    a. Thermocline & pycnocline
    b. Mixing barrier, upwelling and biological productivity with latitude
7. Buoyancy
    a. Archimedes Principle
    b. Plimsoll lines
8. Pressure
    a. Changes with depth
    b. Calculation of pressure at depth
    c. Diving physics
        1. Decompression sickness (DCS) = the bends
        2. Nitrogen narcosis
    d. Marine life adaptations to pressure changes: swim bladders
9. Salinity
    a. Average salinity of seawater
    b. Parts per thousand
    c. Constancy of Composition
    d. Haloclines
    e. Changes with latitude
    f. Sea ice formation
    g. Osmoregulation
10. Sound
    a. Why is sound often more useful underwater than in air?
    b. Speed of sound in water
    c. Determining directions to sound sources underwater
    d. Shadow zone (afternoon effect)
    e. SOFAR channel
    f. Marine life adaptations
        1. Lateral lines
        2. Cetacean sonar

I. Wind Patterns and Causes
1. What causes wind? (air movement)
    a. Convection
    b. Coriolis effect
2. The Major Wind Belts
3. Cyclones, Hurricanes and Typhoons
4. Weather Fronts on weather maps

J. Oceanic Circulation
1. Horizontal Circulation
    a. Gyres
    b. Ekman Spiral
    c. Geostrophic currents
    d. Westward intensification
    e. The major ocean surface currents
        1. Atlantic
        2. Pacific
        3. Antarctic
            a. Polar Easterlies: East Wind Drift
            b. Antarctic Circumpolar Current: West Wind Drift
        4. Indian
            a. Seasonal monsoons
2. Vertical Circulation
    a. Wind-induced; upwelling and downwelling
    b. Thermohaline

K. El Nino

L. Waves
1. Deep water waves
2. Wave anatomy
3. When does a wave break?
4. When does a wave ‘feel’ the bottom?
5. Fully developed sea
6. Fetch
7. Swell
8. Surface waves
9. Body waves
10. Tidal waves

11. Bow waves
12. Interference
13. Standing waves
14. Rogue waves
15. Surf
16. Wave refraction

M. Tides
1. Typical tidal ranges and periods
2. Basic theories and causes of the tides
3. Relationships and correlations with the phases of the moon
4. Types of tides:
    a. Diurnal, semi-diurnal and mixed
    b. Spring and neap tides
5. Tides in Narrow Bays
6. Tidal Bores

N. Tsunamis

O. Marine Life
1. Identification/familiarity with the morphology of the basic types of marine life
2. Common Marine Habitats and Ecosystems
3. Understanding of how different types of marine life cope with life in seawater

P. Oceanic Resources & Environmental Oceanography
1. Rock and Mineral Resources
2. Biological Resources
3. Water Resources
4. Physical/Other Resources (energy, commerce, recreation, etc.)
5. Impacts of Use; pollution, depletion, etc

Q. Law of the Sea

VI. METHODS OF INSTRUCTION:

A. textbook, and students may use textbook publisher provided online and/or interactive materials; may include study guides, online recordings/explanations, etc.

B. **Lecture** - may include powerpoint, videos, internet resources, student activities, group work, demonstrations, CD-ROM images/animations, video clips, internet resources, etc.

VII. TYPICAL ASSIGNMENTS:

A. Read Chapters 1 thru 4. Look up the vocabulary words in these chapters and complete online Vocabulary Quiz
1. Use the textbook glossary and index, the Geologic Dictionaries available in the Science Center, and Internet search engines such as Google.

B. Marine Life Homework: learn to identify the basic types of marine life from photos and video clips. The major in-class exams will include marine life photo identification.

C. Complete the Study Guide questions for Exam 2.

D. Locate the following oceanic features, islands and locations and learn how to find them on geomorphic maps; for example, the Marianas Trench and the Challenger Deep, the East Pacific Rise, the 90 East Ridge, Easter Island, the Monterey Submarine Canyon, the Great Barrier Reef, the Maldives, the Galapagos, the Falkland Islands, the Sandwich Islands, etc. Use the textbook, the maps in the textbook and the Internet – National Geographic Map Machine and Google Image searches.

E. Read Chapter 15 in the textbook.
1. Look up all vocabulary for this chapter.
2. Learn to identify the geomorphic features in this chapter in satellite images and regular aerial and ground photos.
3. Make sure that you understand the basic geologic processes discussed in this Chapter.
4. Complete the questions in the Study Guide that refer to the topics in this chapter.

F. Research Paper. Submit a 5-10 page 12-point paper on a geologic topic approved by the instructor.

G. Presentation. Create and present a 5-10 minute presentation on a geologic topic approved by the instructor.

VIII. EVALUATION:

A. **Methods**

1. Exams/Tests
2. Quizzes
3. Research Projects
4. Portfolios
5. Papers
6. Oral Presentation
7. Projects
8. Field Trips
9. Simulation
10. Group Projects
11. Class Participation
12. Class Work
13. Home Work
14. Other:
    a. Homework – can include vocabulary, marine geography, marine life identification, and textbook material not covered in class presentations
    b. Quizzes and Midterms– can include short answer, multiple choice, and essay questions; includes photo interpretation and identification of oceanic features and marine life, identification and interpretation of oceanic features from geomorphic maps
    c. On-Line Quizzes and/or Essays – may use the textbook website quizzes and/or Blackboard Quizzes – online quizzes are at the discretion of the instructor
    d. Final examinations – comprehensive, similar layout to quizzes and midterm examinations

B. **Frequency**

1. Homework can be assigned daily, weekly or all at the beginning of the term or only as needed, at the discretion of the instructor
2. Quizzes will be given daily, weekly, bi-weekly or at the discretion of the instructor
3. Quizzes/Midterms/Final Exam/Term Paper – at least 3 or 4 total. For example, there may be 2 midterms, one final exam and one term paper. Or, there may be 4 on-line quizzes, 3 in-class midterms and one in-class final exam.
4. The comprehensive Final Exam will be given at the end of the semester on the day specified in the campus Final Exam schedule.
5. Other modes of evaulation, such as research projects, portfolios, papers, presentations, projects, field trips, simulations, group projects, class participation, etc, are at the instructor's discretion (there may be none, one, or several).

IX. TYPICAL TEXTS:

1. Garrison, . (2016). *Oceanography with Infotrac* (9th ed.). Pacific Grove, California: Brooks-Cole Publishers.
2. Thurman, H.V. and Trujillo, A.P. (2004). *Introductory Oceanography* (10th ed.). Upper Saddle River, New Jersey: Prentice-Hall Publishers. .
3. Thurman and Trujillo, . (2017). *Essentials of Oceanography, with CD-ROM,* (12th ed.). Upper Saddle River, New Jersey, NJ: Prentice-Hall Publishers.
4. Sverdrup, K., & Armbrust, V. (2009). *An Introduction to the World's Oceans* (10th ed.). San Francisco, California: McGraw-Hill Publishing.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. A) Access to the internet and computers, through the LPC Computer Center, or a location such as a public library, or access to a personal computer at home with an internet connection, and B) Study guides as made available by the instructor