Physical Oceanography
Biology 610
Spring 2017

Lecture GML 202: M&W: 09:00-10:30
Laboratory GML 202 and/or 113: M&W 10:45-13:45
Instructor: Dr. Jack DiTullio: GML, Rm. 204; phone: 953-9196 (ditullioj@cofc.edu)
[Office hours: M&W 14:00 – 15:00 and by appointment]

This schedule is a general outline of the material that will be discussed each day. Please note, however, we will probably deviate from it somewhat as the course progresses. The outline is simply meant to be an overview of the topics to be discussed in roughly the order they will be covered. Some topics may take more or less time than listed.

	Date		Topic
Jan	11	W	Introduction, Origin of Universe, Earth & Oceans
	16	M	No Class—MLK Day
	18	W	Marine Geology/Geophysics/ Plate Boundaries
	23	M	Marine Geology: Deep Sea Sediments
	25	W	Chemical/Physical Oceanography: Properties of H_2O, salinity, density
	30	M	Chemical Oceanography: Global and Marine Carbon Cycles
Feb	01	W	Chemical Oceanography: Marine Nutrient Cycles
	06	M	Meteorology; Gradient and Geostrophic Wind Systems
	08	W	Heat Budget, Hydrologic Cycle, Atmospheric-Oceanic Coupling
	13	M	Temperature, Salinity, Density Relations, Water Column Stability
	15	W	Surface Currents, Circulation & Frontal Boundaries
	20	M	Thermohaline circulation (Deep Ocean Circulation)
	22	W	**EXAM I**
	27	M	Equations of motion, Continuity, Coriolis Force
Mar	01	W	Hydrostatic Equation, Geostrophic Currents, Two-layer Ocean
	06	M	Spring Break
	08	W	Spring Break
	13	M	Geostrophic Eddies, Sea Surface Dynamic Topographies
	15	W	Friction, Viscosity, Wind Stress, Turbulence
	20	M	Ekman Currents, Geostrophic Subtropical Gyres,
	22	W	Vorticity, Westward Intensification of Boundary Currents
	27	M	**EXAM II**
	29	W	Coastal Upwelling

Apr	03	M	Waves, Internal Waves, Tsunamis
	05	W	Tides & Tide Generating Forces
	10	M	Estuaries, Coastal Oceanographic Processes
	12	W	Equatorial Circulation
	17	M	El-Nino Southern Oscillation (ENSO), Planetary Waves
	19	W	Long-term Oceanic Oscillations and Teleconnections
	24	M	Biogeochemical Cycles and Climate Change in the Oceans
	26	W	Climate Feedback Loops
May	01	M	**FINAL EXAM**

Texts: There is no one textbook required for the course as we will cover material from many different sources. A good general physical oceanographic textbook is *Descriptive Physical Oceanography*, Talley et al., 6th edition, 2011, ISBN: 978-0-7506-4552-2. In addition, a good general introductory textbook on Oceanography is also recommended such as *Introduction to Ocean Sciences*, 2007, Douglas Segar, 2nd edition. ISBN-13: 978-0-393-92629-3 or the 3rd edition which is available for **FREE** online: http://reefimages.com/oceans/oceans.html
There is a link for user donations. Please contribute (e.g. a couple of dollars) to help cover the labor and editorial costs that make this resource available. I believe Dr. Segar has also updated the link so that you can highlight and make notes on the pdf using Adobe Pro.
Any other general introductory ocean sciences textbook can be substituted for this text as well. While we will cover some basic oceanographic principles in class, because of time constraints you will be expected to cover some of the general oceanographic knowledge found in those introductory textbooks on your own. The Open University (Pergamon Press) also has a very good set of paperback books on various oceanographic topics including *Ocean Circulation*. In addition, another good dynamical PO book that is recommended is *Introduction to Physical Oceanography* by Knauss and Garfield, 2017, ISBN: 978-1-4786-3250-4. Finally, you may also download the on-line text *Introduction to Physical Oceanography* textbook by Robert Stewart at the following link: http://oceanworld.tamu.edu/home/course_book.htm

Course Objective: To introduce students to multi-disciplinary marine sciences specifically focusing on geological, chemical and physical oceanographic concepts and principles. The main emphasis of the course will be on physical forces in the ocean, especially those forces that drive ocean currents, planetary forces, fluid dynamics and wind-driven and thermohaline circulation. Coastal processes including estuaries, tidal influences, wave dynamics, and coastal upwelling will also be covered.

Student Learning Outcomes:

- Students will learn important principles of both descriptive and dynamic physical oceanographic processes.
- Students will learn how to solve various numerical problems relating to physical oceanography including equations of motion and calculating Ekman and geostrophic current velocities.
- Students will gain an understanding of concepts relating to the Earth's heat budget and atmospheric-oceanic coupling by solving analytical problem sets.
- Students will lead journal discussions from important peer reviewed literature.

- Students will gain field experience by designing and implementing the collection of oceanographic data using a CTD system. Temporal and spatial variability in various physical-chemical parameters will be observed during three field expeditions in Charleston Harbor.
- Students will learn how to analyze seawater for various chemical components including nutrients such as phosphate and silicate and the marine dissolved inorganic carbon system including carbonate and total alkalinity
- Students will demonstrate an ability to collect, assimilate, synthesize and interpret oceanographic datasets from distinct oceanographic regimes using various databases such as OceanDataView and ARGO Float datasets. Class presentations interpreting their regional data will be presented in a power point presentation to the class.

Policies and Requirements: This course will be conducted strictly in accordance with the honor system of the College of Charleston (http://www.cofc.edu/studentaffairs/HonorBoard.htm). All work that you turn in for this course (whether for a paper, exam or quiz) must be your own, and have not been used, partially or totally, to fulfill requirements for other classes. Any form of plagiarism (intentional and unintentional), cheating, or presenting someone else's work as one's own will be treated as a serious academic transgression and will be communicated accordingly by the instructor as an honor code violation to the Division of Student Affairs.

All activities performed as part of the BIOL 610 Laboratory in room GML 113 will fall under the College of Charleston Safety Policies and Procedures (Full version has been handed to you with this syllabus, please read them carefully).

According to this college-wide policy: *"Students dismissed from a teaching lab due to violations of the safety procedures will not be allowed to re-enter the laboratory until authorized to do so by their supervisor (instructor). Any course work missed because of a violation of these guidelines cannot be made up at another time (or by an extension of the lab period) and will be treated as an unexcused absence"*

Laboratories: The laboratory portion of the course will include problem sets, chemical lab analyses and some computer analyses. The labs will be held in either the classroom (Rm. #202) or in Rm. # 113. The laboratories will consist of chemical analyses, journal discussions, debates, demonstrations as well as hands-on experiments. Various homework assignments will count toward the lab grade. Problem sets will be assigned for some of the labs and lab write-ups will be required for all. Students will also be required to pass a short course on small boat handling as part of their lab grade. Two harbor samplings on a small boat and a 3 hr harbor cruise aboard the R/V *Silver Crescent* on April 03 and 05, 2017 will be conducted to collect physical and chemical oceanographic data using a CTD (conductivity –temperature-depth) system. Note that all boating operations are weather dependent. More information on cruise specifics will be given the week before the lab. In addition, each student will be required to present a power point-presentation (15 min) on the variability of physical oceanic properties in a certain oceanographic province using various oceanic databases (e.g. Ocean Data View, ARGOS floats etc.). These presentations will be done on the last week of classes (April 24/26). The ODV program can be found on the computers in the GML computer lab. You can download the program onto your laptops using the

following link: http://odv.awi.de/en/software/download/

Please note that the topic of your presentation must be submitted before spring break. A written report of the presentation and harbor sampling lab must be submitted on or before April 26th.
Grades: Final grades will be determined using the following format:

Exam I---------- 20%
Exam II---------- 20%
Final Exam---------- 25%
Labs---------- 15%
Presentations-------- 10%
Problem Sets-------- 10%

Exams will cover all assigned readings as well as lecture material. Exams will consist of mostly essay type questions and a few problems. The final exam will be a cumulative exam but the emphasis will be on the last third of the semester. Note that class attendance is strongly advised as many lectures will include material taken from various textbooks. Grades will be determined according to the following scale:

A = 91-100
B+ = 86-90
B = 81-85
C+ = 76-80
C = 65-75
F = 0-64

Oceanography Lab
Biology 610, Spring 2017

Teaching Assistant: Rachel Grey (greyr@g.cofc.edu)

Oceanography labs will meet on Mondays and Wednesdays in GML Rm #202. On some labs we will go over to GML Rm. # 113 or possibly to HML Rm # D109.

Some problem sets will be assigned during the course and will contribute to your overall lab grade. Lab reports must be turned in the following week unless otherwise noted. Late lab reports will be penalized 10% per day. Individual power point presentations and a write up will be worth a total of 10% of the final grade. More information on the power point presentation will be provided in lab class. Journal article discussions will periodically be assigned and each student is expected to lead a discussion. A class debate on climate change and geoengineering will be held and all students will be required to read the paperback book *Fixing Climate* by Wallace S. Broecker and Robert Kunzig (2008), ISBN: 978-08090-4502-0. Further details on the class debate will be provided during one of the first lab periods. A Final Charleston Harbor Lab Report will be due on April 24/26 and is worth the equivalent of 3 individual lab grades.

Date	Topic
Jan	
11	No Lab- Plate tectonics assignment
16/18	No Lab---MLK Day
23/25	Bathymetry and contouring
Feb	
30/01	Plate tectonic presentations + Planet Earth Video
06/08	Total CO_2, Alkalinity & the Carbonate Buffering System in Seawater +JD
13/15	Charleston Harbor Sampling on R/V *Chamberlain*
20/22	Measurement of the Primary Nutrients in Seawater + JD
27/01	Spectrophotometric and Fluorometric Pigment Analyses +JD
Mar	
06/08	No Labs --- Spring Break
13/15	Charleston Harbor Sampling on R/V *Chamberlain* +journal discussion (JD)
20/22	Oxygen Measurements +JD
27/29	Charleston Harbor Sample Analyses
Apr	
03/05	Charleston Harbor Cruise aboard R/V *Silver Crescent*
10/12	Charleston Harbor Sample Analyses +JD
17/19	Class Climate Debate
24/26	Class Presentations ------- Regional Oceanography Papers Due