MAR 555: Introduction to Physical Oceanography

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Course Description and Requirement:

This course is aimed principally at understanding the structure and dynamics of the oceanic circulation, water mass formation, waves, tides and turbulent mixing over global-basin-regional-coastal-estuarine scales. It is designed for graduate students in an interdisciplinary field of marine science whose concentration is not pure physical oceanography. Students will learn the basic concepts and dynamics that drive and influence multi-scale physical processes that are related to fisheries, biological and chemical oceanography. Students will be evaluated on their knowledge and ability to apply the basic principles of oceanic dynamics to explain the complex interdisciplinary oceanic system.

Lectures comprise 8 major topics: 1) How the Atmospheric-Ocean System Is Driven; 2) The Upper Oceanic Circulation; 3) The Oceanic Water Masses; 4) The Deep Oceanic Circulation; 5) Fundamental Dynamics of Oceanography; 6) Oceanic Waves and Tides; 7) Coastal Physical Processes; and 8) Physical Processes in the Gulf of Maine and New England Shelf

Students will be evaluated based on their class participation and homework (25%), a closed book prelim (25%), an open book prelim (25%), and an open book final examination (25%). Tests will be geared towards process-oriented problems requiring integration of materials from lectures and review sessions.

Homeworks are due on the day of the recitation and include all homework questions assigned since the previous recitation. Homeworks must be maintained in a comprehensive portfolio that will be examined cover to cover on the last day of class.

Website
Course materials (lecture notes, supplementary reading, movies, etc.) are located at:
http://fvcom.smast.umassd.edu/Courses/MAR555/index.html. Broken links, please notify instructor G. Cowles. Note if there is a change in the schedule, the web site will be kept up to date.

Recommended Textbooks:

"Ocean Circulation" prepared by the Open University
"Introductory Dynamical Oceanography" by Stephen Pond and George L. Pickard

"Introduction to Physical Oceanography", by Bob Stewart. PDF and html content at: **http://oceanworld.tamu.edu/resources/ocng_textbook/contents.html**

In addition, the lecture notes for each topic will be provided to the students and power point presentations used for the lectures will be made available online.

Class Time: 4:00 to 5:15 PM on Monday;
3:30 to 4: 45 PM on Tuesday and Thursday

Class Schedule:

T	Sep 2	-	Fall classes begin: 1) introduce instructors, 2) give a brief description on the course and requirement; 3) answer students' equations regarding the course.	All
R	Sep 4	**1**	How the Atmospheric-Ocean System Is Driven, part I: The Heat Balance on the Earth System	Chen
M	Sep 8	**2**	How the Atmospheric-Ocean System is Driven, part II: Oceanic heat budget	Chen
T	Sep 9	**3**	Influence of the Earth's Rotation: Coriolis	Chen
R	Sep 11	4	The Upper Oceanic Circulation a) The global wind/pressure fields b) The general pattern of upper-oceanic circulation c) Subtropic Gyres	Chen
M	Sep 15	**5**	Gulf Stream rings	Chen
T	Sep 16	**R**	*Class exercise and homework discussion*	Cowles
R	Sep 18	**6**	Math and Physics Background	Goodman
M	Sep 22	**7**	The North Atlantic Subpolar gyre a.) The North Atlantic Eastern Boundary Currents b.) The South Atlantic Circulations	Chen
T	Sep 23	**8**	The Atlantic Equatorial Current System: surface currents; equatorial undercurrent	Chen
R	Sep 25	R	*Class exercise and homework discussion*	Cowles
M	Sep 29	**9**	The Pacific Ocean Circulation System **:** Subtropic/subpolar gyres; Kuroshio; Pacific Ocean equatorial currents	Chen
T	Sep 30	**10**	Antarctic Circumpolar Circulation	Chen
R	Oct 2	**11**	Oceanic Water Masses:	Chen

			a.) definition, methods and T/S analysis; b.) upper, intermediate, deep and bottom water	
M	Oct 6	**12**	Oceanic Water Masses (continued)	Chen
T	Oct 7	**13**	The Oceanic Deep Circulation: simple classical theories , a two-layer model, observational patterns of the inter-basin circulation	Chen
R	Oct 9	R	*Review of lectures 1-12 and prepare for prelim I*	Cowles
M	Oct 13		*No Class-Columbus Day*	
T	Oct 14	E	**PRELIM I (closed book)**	
R	Oct 16	**14**	Dynamics of Oceanography The governing equations (IPO-7)	Goodman
M	Oct 20	**15**	Concepts: Buoyancy and Vorticity (IPO-6, 12)	Goodman
T	Oct 21	**16**	Frictional Effects and Turbulence: Pt I (IPO-8)	Goodman
R	Oct 23	**17**	Frictional Effects and Turbulence: Pt II (IPO-8)	Goodman
M	Oct 27	**18**	Geostrophic Currents (IPO-10)	Goodman
T	Oct 28	R	*Class exercise and homework discussion*	Goodman
R	Oct 30	**19**	Surface waves**:** wind-generated waves; Langmuir cells; wind-induced inertial oscillations	Cowles
M	Nov 3	**20**	Tides: equilibrium theory	Chen
T	Nov 4	**21**	Coastal tides and internal tides	Chen
R	Nov 6	**22**	Internal Waves and Inertial Waves	Cowles
M	Nov 10	**23**	Kelvin and Rossby Waves	Cowles
T	Nov 11		No Class Veterans Day	
R	Nov 13	**R**	*Class exercise and homework discussion*	Cowles
M	Nov 17	**R**	*Review of Lectures 14-23 and prepare for prelim II*	Cowles
T	Nov 18	**E**	**PRELIM II (CLOSED BOOK)**	
R	Nov 20	**24**	Coastal Oceanic Processes**-**oceanic frontal system	Chen
M	Nov 24	**25**	Oceanic-frontal system (continued)	Chen
T	Nov 25	**26**	Mixing in the Ocean **(IPO-9)**	Goodman
R	Nov 27		NO CLASS THANKSGIVING	
M	Dec 1	**27**	Response of the Upper Ocean to Winds **(IPO-9)**	Goodman
T	Dec 2	**28**	Bottom Ekman Layer	Goodman
R	Dec 4	**R**	*Class exercise and homework discussion*	Goodman
M	Dec 8	**29**	Topical Lectures	TBD
T	Dec 9	**30**	Topical Lectures	TBD
R	Dec 11	**R**	Homework Portfolio Review	TBD
T	Dec 16	EX	**Final exam (open book).**	