



Introduction to Physical Oceanography

OCOR-5608

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Summer 2008 (evolving)

Pre-requisites:

Algebra and Physics

Textbooks:

- Open University Course Team. 2001. *Ocean Circulation* (Second Edition), Butterworth-Heinemann.
- Open University Course Team. 2000. *Waves, Tides and Shallow-Water Processes* (Second Edition), Butterworth-Heinemann.

Outline

This course is intended to give students an understanding of how wind, radiation, gravity, friction, and the Earth's rotation determine the ocean's temperature, salinity patterns and currents. Some important processes we will study include heat budget of the oceans, exchange of heat with the atmosphere and the role of the ocean in climate, surface mixed layer, waves in the ocean, geostrophy, Ekman transport, and Rossby waves. Students will learn how to explain physical features of the ocean ranging from microscopic turbulence to global circulation.

Course Syllabus (11-week summer term)

1. Introduction. What is physical oceanography and why should I care?
2. Seawater Properties and Tools for Measurements
3. Rotation and Dynamics
 - Math review: vectors, scalars etc.
 - The Coriolis force
 - Geostrophy
4. Wind-Driven Circulation I
 - The equations of motion

- Ekman transport and pumping
 - Coastal upwelling and downwelling
5. Wind-Driven Circulation II
- Gyres of the world
 - Sverdrup relation
 - Potential vorticity
 - Western intensification
 - Equatorial circulation
 - Antarctic Circumpolar Current
6. Buoyancy-Driven Circulation
- Global distribution of temperature and salinity
 - Water masses
 - How deep water forms
 - Buoyancy-driven flows I: No rotation
 - Buoyancy-driven flows II: Deep Western Boundary Currents
7. The Big Picture: Oceans and Climate (same week as midterm)
- Basics of climate
 - Why the ocean is important for climate

Midterm Exam

8. Gravity Waves and Mixing
- What is a wave?
 - Dispersion
 - Internal waves
 - Instabilities: Kelvin-Helmholtz, salt fingers, Langmuir circulation
 - Turbulence
 - Mixed layer evolution
9. Waves in Rotating Fluid; Eddies
- Poincare waves and Kelvin waves
 - Rossby waves
 - Instability of geostrophic currents
 - Mesoscale eddies in the ocean
10. Tides and Coastal Processes
- Tidal forcing
 - Large scale tides
 - Tides near coasts
 - Estuaries
 - River outflow plumes
 - Fronts
11. Monsoons and El Nino (same week as final exam)
- monsoon circulation
 - equatorial waves
 - El Nino-Southern Oscillation

Final Exam

Grades

	%
Quizzes	10
Forum Discussions	30
Mid-Term Exam	20
Term Paper: 20	
Final Exam: 20	
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Total	100%

Quizzes

8 multiple-choice quizzes (plus the first training quiz)

Midterm Exam

Based on Units 1-6.

Final Exam

Based on Units 7-11.

Additional Reading

Other General Texts:

- Knauss, J.A. 1996. *Introduction to Physical Oceanography* (Second edition), Prentice Hall.
- Pond, S. and G.L. Pickard. 1983. *Introductory Dynamical Oceanography*. Oxford, Butterworth-Heinemann.
- Pickard, G.L., and K.O. Emory. 1990. *Descriptive Physical Oceanography*. (Fifth Edition), Butterworth-Heinemann. (Basic features of the ocean, observational methods, and descriptions of each oceanic region.)

More Advanced texts:

- Soloviev, A. and R. Lukas, 2006. *The Near-Surface Layer of the Ocean: Structure, Dynamics, and Applications*. Springer, Netherlands, 572 pp.
- Mellor G.L. 1996. [*Introduction to Physical Oceanography*](#), Springer.
- Pedlosky, J. 1987. *Geophysical Fluid Mechanics*. Springer-Verlag (In-depth theoretical treatment of large-scale dynamics of the ocean and atmosphere.)
- Gill, A.E. 1982. *Atmosphere-Ocean Dynamics, Volume 30*. Academic Press. (Especially good for treatment of waves in the ocean.)

- Kundu, P. 2004. *Fluid Mechanics*. Academic Press. (An outstanding textbook, including many topics relevant to physical oceanography, written by a late NOVA faculty member.)

Journals:

The most-read journals for physical oceanography are

- [*Journal of Physical Oceanography*](#) (available full-text through NSU electronic library)
- [*Journal of Geophysical Research – Oceans*](#)

Other important journals: (all available full-text through the NSU electronic library)

- *Boundary-Layer Meteorology*
- *Deep Sea Research Part I: Oceanographic Research Papers/ Part II: Topical Studies in Oceanography*
- *Tellus. Series A, Dynamic Meteorology and Oceanography*
- *Dynamics of Atmospheres and Oceans*
- *Progress in. Oceanography*
- *Journal of Climate*
- *Continental Shelf Research*
- *Journal of Fluid Mechanics*