Marine Hydrodynamics
MSCI/GEOL-582; Spring 2012

Instructor: Alexander Yankovsky, office EWS-308, 7-3550, ayankovsky@geol.sc.edu

Course description: Momentum, mass, energy and vorticity balance equations describing the ocean dynamics. Theoretical description of major types of wave motions in the ocean including surface and internal gravity waves of different scales, waves affected by the Earth's rotation, planetary waves, and waves in the boundary regions. Identification of waves in the observational data.

Learning Outcome:

- Students will be introduced to the hydrodynamics wave problems for different types of wave motions in the ocean. This will include the choice of governing equations and the application of appropriate boundary conditions, the scale analysis and simplifying approximations, and the understanding of basic solution techniques.

- Students will understand the major types of waves by their restoring forces, linear dispersion relations, structure of fluid motion, and waves' contribution to the variability of oceanic fields (velocity, density, pressure, etc.).

- Students will learn the principles of energy and vorticity conservation and how they are applied to wave dynamics. They will learn the basics of numerical methods for the wave problem solutions.

- Class will yield sufficient knowledge for the detection of wave signals in the observational data and/or in the primitive equation numerical model output.

Grades: Undergraduate students: quizzes (6 best) - 30%, tests – 60%, attendance and participation in the class (including paper reviews) - 10%. Graduate students: quizzes (6 best) - 30%, tests – 60%, term project - 10%. Final grade will be based on the following grading scale: 90≤ **A**; 86≤ **B+**<90; 80≤ **B**<86; 76≤ **C+**<80; 70≤ **C**<76; 66≤ **D+**<70; 60≤ **D**<66; and **F**<60.

Meeting Schedule: Monday and Wednesday 8:40-9:55 AM, EWSC 209.

Office hours: Tuesday 1:00-3:00 PM or by appointment.

Credit hours: 3.

Course Text:

Pedlosky, J., 2003. *Waves in the Ocean and Atmosphere. Introduction to Wave Dynamics*. Springer, 268 pp.

Supplementary recommended texts:

Baines, P. G., 1995. *Topographic Effects in Stratified Flows*, Cambridge Univ. Press, 482 pp.

Gill, A. E., 1982. *Atmosphere-Ocean Dynamics*, Academic Press, 662 pp.

Kundu, P., and I. M. Cohen, 2008. *Fluid Mechanics*, 4th Edition. Academic Press, 872 pp.

Pedlosky, J., 1987. *Geophysical Fluid Dynamics*, 2nd Edition, Springer-Verlag, 710 pp.

Prerequisite: Differential Equations and PHYS201 or 211.

Tentative Weekly Schedule

1/9-1/11	Introduction. Wave kinematics.
1/18	Kinematic generalization.
1/23-1/25	Equations of motion. Surface Gravity waves. Boundary conditions. **Quiz**.
1/30-2/1	Plane wave solution. Fields of motion in gravity waves. **Quiz**.
2/6-2/8	Energy and energy propagation. **Quiz**.
2/13-2/15	Internal gravity waves. **Quiz**.
2/20-2/22	Internal waves, group velocity and reflection. **Test 1** (take home).
2/27-2/29	Test 1 review. WKB theory for internal gravity waves.
3/5-3/7	***Spring break***
3/12-3/14	WKB theory (continued). **Quiz**.
3/19-3/21	Earth rotation and potential vorticity. **Quiz**.
3/26-3/28	Large-scale hydrostatic motions. The Rossby adjustment problem. **Quiz**.
4/2-4/4	Poincaré and Kelvin waves. Channel wave modes. **Quiz**.
4/9-4/11	Waves in boundary regions. **Test 2** (take home).
4/16-4/18	Rossby waves. **Term paper presentations**.
4/23	**Term paper presentations** (continued).