Instructor: Samar Khatiwala (spk@ldeo.columbia.edu)
Lamont: Oceanography 204, 845-365-8454; Mudd: 292C, 212-854-8111
Office hours: TBD

Course home page: http://www.ldeo.columbia.edu/~spk/Classes/APPH4210_GFD/

Course description: This is an introductory course on the large scale dynamics of rotating geo-
physical and planetary fluids such as the ocean and atmosphere. The focus of this class will be
on using simplified physical and mathematical models to understand how the ocean and atmo-
sphere “adjust” when perturbed by “external” forces. This adjustment is strongly modified by the
combined effects of gravity and rotation, and largely manifested through “waves”. A variety of
processes fundamental to how the ocean and atmosphere operate can be understood by studying
these wave motions, and that is the approach we will take. This class is a prerequisite for more
advanced courses in climate studies, atmospheric science, and physical oceanography.

Topics to be covered include: Review of the governing equations of mass and momentum
conservation; wave kinematics, dispersion, group velocity; surface and internal gravity waves;
shallow water theory; stratified fluids and normal mode analysis; waves in rotating fluids: Kelvin,
Poincare, and Rossby waves; the Rossby adjustment problem and conservation of potential vortic-
ity; the quasi-geostrophic approximation; planetary waves and Charney-Drazin theory; barotropic
and baroclinic instability theory.

Prerequisites
Basic linear algebra and PDEs; a course in fluid dynamics such as Physics of Fluids (E4200); some
knowledge of programming would be useful.

Texts:
Strongly recommended: Gill, A.E. Atmosphere-Ocean Dynamics (2nd edition), Academic Press,
1982.
Suggested reading:
Kundu and Cohen, Fluid Mechanics, Academic Press. (This book is pretty good if you need to
review basic notions of fluid dynamics.)
The first three books will be on reserve in the engineering library.

Grading: Homework 40%; Midterm 20%; Final 40%.