OCP 5253 Introduction to Geophysical Fluid Dynamics
<u>Course Syllabus, Spring Semester, 2000</u>
T, TR 12:30 – 13:45   Room 327 OSB

<u>Instructor:</u>

Professor Doron Nof, 419 OSB
OFFICE HOURS T/TR 11:30 – 12:30   Dept Ph 644-6700; Direct Ph 644-2736

<u>Course Description:</u>

The purpose of this graduate class is to introduce the student to the basic principles governing the motion of fluids on a planetary scale. The primary effects that will be discussed are the effects of rotation and stratification on fluid motions. The focus will be on motions in oceans and atmospheres (on earth and other planets).

<u>Textbooks:</u>

The class will be based on Cushman-Roisin's *Introduction to Geophysical Fluid Dynamics"* with supplements from Stern's *Ocean Circulation* Physics, Salmon's *Lectures on Geophysical Fluid Dynamics* and Pedlosky's *Geophysical Fluid Dynamics*.

<u>Lecture and Course Outline:</u>

1. Introduction
    a. Objective
    b. Importance of geophysical fluid dynamics
    c. Scales of motion
    d. Importance of rotation
    e. Importance of stratification
    f. Important distinctions between the oceans and atmosphere

2. The Coriolis Force
    a. Motivation for the choice of a rotating reference framework
    b. Rotating frame of reference
    c. Unimportance of the centrifugal force
    d. Motion of a free particle on a rotating plane
    e. Acceleration on a three-dimensional rotating earth

3. The Governing Equations
    a. Momentum equations
    b. Other governing equations
    c. The Boussinesq approximation
    d. Further simplifications
    e. The equations governing geophysical flows
    f. The Rossby and Ekman numbers

4. Geostrophic Flows and Vorticity Dynamics
    a. Homogeneous geostrophic flows
    b. Homogeneous geostrophic flows over an irregular bottom
    c. Generalization to nongeostrophic flows
    d. Vorticity dynamics

5. The Ekman Layer
    a. The importance of friction
    b. The bottom Ekman layer
    c. The surface Ekman layer
    d. The Ekman layer in real geophysical flows

6. Linear Barotropic Waves
    a. Linear wave dynamics
    b. The Kelvin wave
    c. Planetary waves (Rossby waves)
    d. Topographic waves
    e. Analogy between planetary and topographic waves

7. Barotropic Instability
    a. Introduction
    b. Waves on a shear flow
    c. Bounds on wave speeds and growth rates

8. Large-Scale Ocean Circulation
    a. Some remarks on the ocean and atmosphere
    b. A simple model of midlatitude circulation
    c. Sverdrup transport
    d. Westward intensification

9. Stratification
    a. Introduction
    b. Static stability
    c. A note on atmospheric stratification
    d. The importance of stratification: The Froude number
    e. Combination of rotation and stratification

10. Layered Models
    a. From depth to density
    b. Potential vorticity
    c. Layered models

11. Stratified Geostrophic Dynamics
    a. Thermal wind
    b. Geostrophic adjustment
    c. Energetics of geostrophic adjustment

12. Quasi-Geostrophic Dynamics
    a. Simplifying assumption
    b. Governing equation
    c. Energetics
    d. Planetary waves in a stratified fluid

13. Baroclinic Instability
    a. Cause for instability
    b. Linear theory
    c. Heat transport
    d. More-general criteria

There will be four class-long examinations (including the final) and approximately ten homework assignments. The accumulated homework grade will replace the lowest examination score. Make-up examinations will not be given but the accumulated homework grade can substitute a zero valued exam score.

Occasionally, the lectures will be supplemented with demonstrations and videos of relevant laboratory experiments. The instructor’s office hours are 11:30 – 12:30 T,TR. The university will be closed on:

Monday, January 17, 2000 Martin Luther King, Jr. Day
Mon-Fri, March 6 – 10, 2000 Spring Break

Reasonable Accommodation

Students with disabilities needing academic accommodations should: 1. Register with and provide documentation to the Student Disability Resource Center (SDRC): 2. Bring a letter to the instructor from the SDRC indicating you need academic accommodations. This should be done within the first week of class. (This syllabus and other class materials are available in alternative format upon request.)

Academic Honor Code

Students are expected to uphold the Academic Honor Code published in The Florida State University Bulletin and the Student Handbook. The Academic Honor System of the Florida State University is based on the premise that each student has the responsibility (1) to uphold the highest standards of academic integrity in the student's own work, (2) to refuse to tolerate violations of academic integrity in the University community, and (3) to foster a high sense of integrity and social responsibility on the part of the University community.