SYLLABUS for SIO178

Geophysical Fluid Dynamics

Winter 2022

Instructor:

Janet M. Becker, jmbecker@ucsd.edu

Office Hours:

Instructor office hours: We have Spiess 330 until 3:50pm so we will have office hours after every class. These office hours are informal problem sessions. Zoom office hours are available by appointment (e-mail me).

Academic Prerequisites: Phys 2C, SIO 177 (or equivalent), Math 18 or Math 20F or Math 31AH or consent of instructor.

Prerequisites by Topic: elementary mechanics, fluid mechanics, differential and integral calculus, elementary ordinary differential equations, vector calculus, linear algebra.

Textbook:

B. Cushman-Roisin and J.M. Beckers (not me!), Introduction to Geophysical Fluid Dynamics, 2nd Edition, available through your UCSD account at:

http://www.sciencedirect.com/science/bookseries/00746142/101

The e-book is available through the UCSD library at the link above. If you prefer, you may purchase the e-book or a hard copy at the UCSD bookstore.

We also plan to read parts of G.K. Vallis' (GKV) new text "Essentials of Atmospheric and Oceanic Dynamics" from Cambridge University Press (not in the bookstore, but available on Amazon as an e-book or paperback).

Canvas and Gradescope: Assignments will be posted on Canvas. You will upload your solutions to the assignments to Gradescope.

Course description: Geophysical Fluid Dynamics (GFD) is the fluid dynamics that describes the large scale motions of the atmosphere and oceans. This course will explore how the Earth's rotation and variations in density govern atmospheric and oceanic circulation. The class will develop a framework for understanding how winds drive ocean currents, why ocean currents are stronger on the western sides of ocean basins (e.g. think of the Gulf Stream), why hurricanes move westward, and how large-scale waves (called planetary waves) can influence sea level and climate.

Topics covered:

1. Introduction to GFD (Chapter 1)
2. Rotational effects: The Coriolis force, the centrifugal force and the geoid (Chapter 2)
3. Conservation laws (mass, momentum and energy, briefly, Chapter 3) and the equations governing geophysical flows: (Chapter 4).
4. Geostrophic flows and conservation of potential vorticity for the shallow water equations: (Chapter 7)
5. The importance of friction: The Ekman Layer (Chapter 8)
6. Linear waves in a homogeneous ocean: Poincare, Kelvin and Rossby waves (Chapter 9)
7. Effects of Stratification: Froude number, layered models (Chapters 11, 12)
8. Internal waves (Briefly, Chapter 13)
9. Stratified Geostrophic Dynamics: Thermal wind, Geostrophic adjustment (Chapter 15)
10. Large scale ocean circulation (Chapter 20)
11. The Thermocline and Overturning Circulation (if time allows, GKV, Chapter 15).

Course grade:

The final course grade will be based on following:

Homework assignments (40%), mid-term exam (20%), and final exam (40%).

Homeworks: We will have weekly homework assignments.

Exams:

- Midterm exam: 10 February 2022, 2-3:20pm, (Thursday).
- Final exam: 17 March 2022, 3-6pm (Thursday).

Course policy and Academic integrity:

1. Homework assignments and solutions are available on the Canvas website.
2. All students are expected to adhere to the UCSD Policy on Integrity of Scholarship. You may discuss homework problems, but must prepare and submit homework reports on your own.
3. Homework must be written clearly and neatly. The homework is due at the time specified on the assignment. No late homework will be accepted.
4. There will be no make-up exams (midterms or final).
5. Asking questions during the lectures is encouraged and appreciated.

Disability Resources: Students requesting accommodations for this course due to a disability must provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD) which is located in University Center 202 behind Center Hall.

Contact the OSD for further information:

T: 858.534.4382

E: osd@ucsd.edu

W: http://disabilities.ucsd.edu