SYLLABUS for SIO178

Geophysical Fluid Dynamics Winter 2024, TuTh 9:30am-10:50pm, NH 101

Instructor:

Janet M. Becker, jmbecker@ucsd.edu

Course format: Lectures will be delivered in person and podcast. A zoom option may be used (internet and technology willing). Podcasts will be posted to Canvas. Exams are in person only.

Office Hours:

Instructor office hours: TBD

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. The e-book is available through the UCSD library:

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

We also may 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 in a rotating reference frame (mass, momentum and energy, briefly, Chapter 3) and the equations governing geophysical flows. (Chapter 4).
- 4. Geostrophic flows. 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: 15 February 2024, 9:30am-10:50am, (Thursday, in person).

• Final exam: 18 March 2024, 8am-11am (Tuesday, in person).

- 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 without a valid reason.
- 4. There will be no make-up exams (midterms or final) without a valid reason.
- 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

Disability Resources, Triton Testing Center: Exams requiring accommodation will be administered by the Triton Testing Center (TTC). Students authorized for accommodation must register with the TTC by completing the student registration form. Once the form is completed (they need only do this once), TTC will review their request and create or update the their RegisterBlast/TTC account. Then, TTC will send the students the RegisterBlast log-in information. If they are a student with accommodations and received their AFA letter(s) for the course(s) they have at the TTC, they can copy and paste their accommodations into the registration form.

How to access your TTC account:

To log into your account for the first time please visit this website, enter your UCSD email address, and select a new password:

https://www.registerblast.com/ucsd/ResetRequest/Password/4

Once you have your password, you can access your account at this link:

https://www.registerblast.com/ucsd/User/Authenticate

Answers to frequently asked questions and information on how to schedule a test may be found at the TTC webpage.

Students must schedule their test with TTC at least 3 days in advance.