AOS 610   Geophysical Fluid Dynamics I
Fall 2023   3 credits
T R 11:00 – 12:15
Room 811 AOSS Building, 1225 West Dayton Street
University of Wisconsin - Madison

Professor Matt Hitchman
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Office Hours: W 1-2 and by appointment
Course Websites: www.aos.wisc.edu/~aos610, canvas.wisc.edu/courses/366004

Required Texts:
(1) Tritton, D. J., *Physical Fluid Dynamics*, 2nd Edition, 1988, Oxford University Press
(2) Holton, J. R., and G. J. Hakim, *An Introduction to Dynamic Meteorology*, 5th Edition, 2013, Academic Press

Reference Texts:
(1) Gill, A. E., *Atmosphere - Ocean Dynamics*, 1982, Academic Press
(2) Kundu, P. K., and I. M. Cohen, *Fluid Mechanics*, 2nd Edition, 2002, Academic Press
(3) Marshall, J., and R. A. Plumb, *Atmosphere, Ocean, and Climate Dynamics*, 2008, Acad. Press
(4) Vallis, G. K., *Atmospheric and Oceanic Dynamics*, 2nd Edition, 2017, Cambridge Press

Selected Classic Texts:
(1) Batchelor, G. K., *An Introduction to Fluid Dynamics*, 1967, Cambridge University Press
(2) Whitham, G. B., *Linear and Nonlinear Waves*, 1974, John Wiley and Sons
(3) Lighthill, J., *Waves in Fluids, 1978*, Cambridge University Press
(4) Pedlosky, J., *Geophysical Fluid Dynamics*, 1979, Springer-Verlag
(5) Lindzen, R. S., *Dynamics in Atmospheric Physics*, 1990, Cambridge University Press

Course Description:
This in-person lecture course includes the following topics in geophysical fluid dynamics (GFD): the equations of motion, basic approximations, the Coriolis force, wave motions, normal modes, gravity waves, friction, turbulence, convective processes, geostrophic adjustment, scaling arguments, Rossby waves, vorticity and potential vorticity.

We will first develop the governing equations and fundamental fluid concepts, apply them to examples from classical fluid dynamics, and then to geophysical phenomena. Fundamental ideas in GFD include convection, stratification, rotation, waves and their interaction with the mean flow, instabilities, mixing and chemical transport. These concepts provide essential tools for investigating the dynamics of the atmosphere and ocean at mesoscale, synoptic, and global scales. They are important for understanding numerical simulations of weather and climate, chemical constituent transport and mixing, and the general circulation of planetary atmospheres.

Grading:
40% - Four problem sets, 10% each
60% - Three closed-book quizzes, 20% each
Course Credit and Expected Outcome: You will receive 3 credits for this course composed of 2 75 minute lectures per week in the Traditional Carnegie definition. This course will increase your understanding of the physical processes and mathematical physics governing the dynamics of the atmosphere and ocean at the graduate level.

Regular and Substantive Student-Instructor Interaction:
This course will engage students in regular and substantive interaction by direct instruction, providing feedback on student work, and by weekly discussion during office hours.

Institutional academic policies and statements are reviewed and updated annually, as needed. They currently include:

- Teaching and Learning Data Transparency Statement
- Privacy of Student Records and the Use of Audio Recorded Lectures Statement
- Campus Resources for Academic Success
- Course Evaluations and Digital Course Evaluations
- Students' Rules, Rights and Responsibilities
- Diversity and Inclusion Statement
- Academic Integrity Statement
- Accommodations for Students with Disabilities
- Academic Calendar and Religious Observances