SIO 214A, FLUID MECHANICS, SYLLABUS – FALL Q 2019
section 979610, 4 units

Instructor: Sarah Giddings, sarahgid@ucsd.edu
Class meetings: 26 September - 05 December 2019, Tu/Th 09:30-10:50
Problem Session: Tu 08:30-09:20 (note that we can adjust this if necessary)
Location: Spiess Hall 330
Office hours: TBD! MESOM 363, or email me to set up an appointment
Website: https://scripps.ucsd.edu/labs/sgiddings/teaching/introduction-to-fluid-mechanics-2019/

Course Summary:
A survey of classical problems in fluid mechanics and approximate techniques of analysis. Topics include kinematics, conservation equations, laminar flows, stability of laminar flows, and turbulent flow through a series of problem vignettes. Prerequisites: Graduate standing or consent of instructor.

Expectations:
Participation in class and problem sessions is critical as I expect you to become proficient at problem solving and intuitive reasoning. While many of the assignments, mini-labs, and participation are not directly graded, a lack of engagement and understanding will be evident during the final oral exam as the content and problem solving approaches build upon each other throughout the quarter. Thus, completing the assignments and participating in class and mini-labs are critical to success. Grades will be based on homework & participation (not graded but must participate in problem sessions, turn in homework, and make your own corrections, 20%), a take-home mid-term (20%), and an oral final exam (60%). Note that while the homework will not receive detailed grading, all homework is assigned a numeric value and missing questions will be penalized relative to the total for that assignment. Furthermore, late homework will be penalized with a significant grade reduction for that particular assignment and late mid-terms will not be accepted.

Ethics:
For most regular homework assignments, I encourage you to discuss with and work with your peers. Sometimes the best way to learn something is to try to explain it to someone else or to see the question from another's perspective. Yet, at times, it is important for you to reflect on what you personally have learned and test your own knowledge boundaries. It is at these times that I may ask you to work independently and to not discuss the assignment or problems with anyone, for example during a take-home exam or in preparation for your final oral exam. I trust that as students pursuing a graduate degree you will follow proper ethical conduct as academic integrity is expected throughout your career. If at any point, you are unsure of the expectations for a particular assignment, please ask. I will maintain a strict policy of ethical conduct throughout the course and follow the appropriate UCSD Academic Integrity process if any violations occur. No exceptions.

References:

Fluid Mechanics, Pijush K. Kundu and Ira M Cohen (KC4), Fourth edition, 2008, Academic Press.

A fifth edition, with one more coauthor Dowling is now available online at http://www.sciencedirect.com/science/book/9780123821003. Even a 6th edition is now available, but we will refer to fourth (KC4) and fifth (KC5) editions.

Other Fluids texts

Introduction to Fluid Mechanics, G. K. Batchelor (GKB), Cambridge University Press

Fluid Mechanics, Lev D. Landau and Evgeny M. Lifschitz (LL), 1959, Pergamon Press.

Lectures on Geophysical Fluid Dynamics, R. Salmon (RS), 1998, Oxford University Press.

Some classical texts that are valuable for specific topics

Boundary-Layer Theory, H. Schlichting (HS), 1968. McGraw-Hill.

Physical Fluid Dynamics, D. J. Tritton (DJT), 1988. Oxford Science.

Fundamentals of Ocean Dynamics, V. M. Kamenkovich, 1977, Elsevier Scientific Publishing Company (www.sciencedirect.com/science/bookseries/04229894/16), the first two chapters emphasize thermodynamic considerations needed in arriving at equations of motion.

Elementary Fluid Mechanics, R. L. Street, G. Z Watters, J. K. Vennard (SWV), seventh edition, 1996, John Wiley and Sons.

Math reference

Methods of Mathematical Physics, P. M. Morse and H. Feshbach (MF I, MF II), 1953 McGraw-Hill.

APPROXIMATE SCHEDULE

Week 1-2: Introduction, mathematics refresher, kinematics
Week 2-3: Conservation laws
Week 4: Boussinesq, Bernoulli, hydrostatics
Week 4 - 6: Problem vignettes (Poiseuille-Couette flow, wind driven flow on a lake, lubrication problem, Stokes first and second problems, Blazius boundary layer, gravity current)
Week 6-8: Vorticity, potential flows, flow around bluff bodies, lift/drag
Week 8-9: Conservation of energy and hydraulics
Week 9: Horizontal convection
Week 10-11: Instability (Raleigh Bernard, KH instability, Reynolds experiment), turbulence, course review