SIO 214A, FLUID MECHANICS, SYLLABUS – FALL Q 2020
section 20949, 4 units

Instructor: Sarah Giddings, sgiddings@ucsd.edu
Class meetings: 01 October - 05 December 2020, Tu/Th 09:30-10:50
Problem Session: Tu 08:30-09:20 (note that we can adjust this if necessary)
***REMOTE Location*: Note that on-line this class is listed as in person, Hubbs Hall 4500. However, due to current COVID-19 conditions, we will start this class entirely remotely (including both synchronous and asynchronous online instruction). If conditions improve during the quarter, we may transition to Hubbs.
Zoom lecture link: contact instructor or view through Canvas
Zoom office hours: TBD! There will be a zoom-link via Canvas, or email me to set up an appointment
Website: Please use Canvas to access lecture recordings and course material. However, course material will also be available at the older course website.
https://sioweb.ucsd.edu/labs/sgiddings/teaching/introduction-to-fluid-mechanics-2020/

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 (TBD due to COVID-19) are critical to success. Grades will be based on homework (20%), a take-home mid-term (20%), and an oral final exam (60%). In prior years, participation was included in the grade, however, during this era of remote instruction, that is not allowed. 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. Also note that some homework will require working with data and/or plotting where you can use your program of choice (e.g., MATLAB, Python, etc.)

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.

Unusual circumstances for Fall 2020:
Given our unusual remote-only situation for Fall 2020, and more importantly, the immense stressors on all of us given the COVID-19 enforced shelter-at-home circumstances, it is likely to be an unusual term. While we have already worked through these conditions since Spring quarter 2020, circumstances are changing frequently and the UCSD campus community continues to learn more about effective online instruction and working from home. Therefore, please be aware that your Professors and Administrators are continuing to adapt at the same time that you are. For example, I have moved course content to Canvas for the first time for this course, so please be patient as there are likely to be glitches. Most importantly, let us all pledge to remain respectful, supportive, and adaptable to ensure that educational goals are met. All participants in the course are bound by the UCSD Code of Conduct, found at: https://students.ucsd.edu/sponsor/student-conduct/policiesandprocedures.html. Please reach out to me directly if there are issues prohibiting your full engagement in the course so that we can find a workable solution.

Online Classroom Instruction Policies:
I will be posting all course material in Canvas, and also sending announcements via Canvas, so please make sure you are able to access Canvas and contact me if you are not.

This course will be taught using live, online audio and visual instruction and will take place during the times indicated above and in the online course schedule. Live lecture attendance is not required, but is highly encouraged so that questions can be asked and answered during the lecture and you can participate in interactive coding practice. Given the occasional disruptions that inevitably occur when using online conferencing tools (due to WiFi drops, service drops, etc.) we will adhere to the following plan of action for each online class meeting:

1. Each course lecture will be initiated using Zoom: (links available through Canvas or contacting instructor)
2. If Zoom fails for a given lecture, we will switch to Explain Everything: (links available through Canvas or contacting instructor)

All lectures will be recorded and posted to Canvas in a timely manner so that they are available asynchronously. Please be aware that you will be recorded if you choose to turn on your video and audio. Lecture notes will always be available in the event that lecture recording fails.

Netiquette:
Hopefully with our small class, this will not be a major issue, however, methods to minimize background noise and to promote clear communications during live online lectures, please keep your microphone on MUTE when you are not talking and consider using headphones. If you have a question, you can either "raise your hand," put a note in the chat, or best, please do unmute yourself and just chime in!

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