

SYLLABUS for SIO177

Fluid Dynamics, Fall 2020, 10-10:50am MWF

Instructor:

Janet M. Becker

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Problem Solving Sessions: Mondays 11-11:50am

Office Hours: Tuesdays, 2-3pm or by appointment (e-mail me)

Academic Prerequisites: Phys 2A, Math 20D and Math 20E or consent of instructor.

Prerequisites by Topic: elementary mechanics, differential and integral calculus, elementary ordinary differential equations, multivariable and vector (differential and integral) calculus. We will review the prerequisites as needed.

Textbook:

P.K. Kundu, I.M. Kohen and D.R. Dowling, Fluid Mechanics, various editions. The 5th edition of this text is available through your UCSD account at:

<https://www.sciencedirect.com/science/book/9780123821003>

The first edition of the text with Kundu as the sole author is more appropriate for this course. We only will use selected sections of this text. Downloading from sciencedirect is strongly encourage. You may, however, purchase the e-book or a hard copy at the UCSD bookstore if you prefer.

Canvas website: Assignments and grades will be posted on Canvas.

Course description: Fluid Mechanics is the study of the behavior

of fluids (liquids and gases) under various forces and in various configurations. This course starts with an introduction to the mechanics of fluids including fluid statics and kinematics. Fluid conservation laws will be presented and used, for example, to describe surface gravity waves and boundary layer flows. Applications will be focused on problems of relevance to oceanic and atmospheric science. SIO 177 is the first course of a two course series with SIO 178, Geophysical Fluid Dynamics, offered in the winter quarter.

Topics covered:

1. Vector calculus: Scalar and vector fields, divergence, gradient, curl, integral theorems (briefly)
2. Fluid fundamentals: Units, continuum hypothesis, transport, statics, classical thermodynamics (parts of Chapter 1).
3. Kinematics: Describing the motion and deformation of a fluid without considering the generating forces (parts of Chapter 3)
4. Conservation laws: Statements of mass, momentum, and energy conservation. Bernoulli equation, boundary conditions, engineering examples (parts of Chapter 4)
5. Ideal Flows: Irrotational motion, velocity potential, two-dimensional stream function and velocity potential (parts of Chapter 6)
6. Gravity waves: Long (shallow water approximation) and short surface gravity waves (parts of Chapter 7)
7. Laminar flows of viscous fluids: Poiseuille and Couette flow, Stokes' first and second problems, Stokes flow past a sphere, Stokes' law of resistance (parts Chapter 8)
8. Boundary layers: thin viscous layers that occur in nearly inviscid fluids near boundaries, boundary layer thickness, drag coefficient (parts of Chapter 9)

Course grade:

The final course grade will be based on following:

Homework assignments (40%), mid-term exam (15%), and final exam (45%).

Homeworks: We will have weekly homework assignments.

Exams:

- Midterm exam: 4 November 2020.
- Final exam: 18 December 2020 8-10:59am.

Course policy and Academic integrity:

1. Homework assignments and solutions will be 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. Online exams will have clear rules provided to students, and will be designed and administered to uphold academic integrity. For problems assigned from the textbook, use of online solutions manuals is prohibited.
3. Lectures will be delivered via Zoom. You are notified that these lectures will be recorded, and that this program uses video and audio recording or other personal information for the purpose of facilitating the course and/or test environment. UC San Diego does not allow vendors to use this information for other purposes. Recordings will be deleted when no longer necessary. However, if cheating is suspected, the recording may become part of the student's administrative disciplinary record."
4. Homework must be written clearly and neatly. The homework is due at the time specified on the assignment uploaded to Canvas. No late homework will be accepted.
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. Students should present their AFA letters to Faculty (please make arrangements to contact me privately) at least two weeks prior to an exam to ensure that accommodations may be arranged.

Contact the OSD for further information:

T: 858.534.4382

E: osd@ucsd.edu

W: <http://disabilities.ucsd.edu>