

Introduction to Mechanics of Fluids

MECE E3100

Instructor: Prof. Vijay Vedula
Dept. of Mechanical Engineering
Mudd 220BA
vv2316@columbia.edu (please use MECE E3100 in your subject heading)

Lectures: Tu/Th, 2 sections per day – 8:40am - 9:55am, 10:10am - 11:25am; Mudd 303

Recitation: Fr 10am - 11am at Mudd 633
Fr 1pm - 2pm at Mudd 233

TAs: Jason Fan (jf3016@columbia.edu)
Erin M. Louwagie (eml2218@columbia.edu)

Graders: Xinsheng Gu (xg2381@columbia.edu)
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Office Hours: Mon 4pm – 5pm (Jason/Erin, zoom)
Tues 4pm – 5pm (Jason, zoom)
Wed 9am – 10am (Erin, zoom)
Office hours with Prof. Vedula by appointment.

Text: Fox, R.W., McDonald, A.T. and Mitchell, J.W., *Introduction to Fluid Mechanics*, 10th ed. Wiley.

References: Kundu, P.K., Cohen, I.M., & Dowling, D.R., *Fluid Mechanics*, 6th ed. Academic Press, 2015.
White, F.M., *Fluid Mechanics*, McGraw-Hill, 2015.
Milton van Dyke, *An Album of Fluid Motion*, Parabolic Press, 1982.

Objective: Provide a broad introduction to the fundamental concepts in fluid mechanics including fluid properties, fluid statics, control volumes and surfaces, kinematics of fluid motion, conservation of mass, linear momentum, Bernoulli's equation and applications, dimensional analysis, the Navier-Stokes equations, laminar and turbulent viscous flows, internal and external flows, and lift and drag. Emphasis is on mathematical formulation, engineering applications, and problem-solving, as well as on developing physical insights into fluid flow.

Outcomes: Students will gain a thorough understanding of the basic concepts in fluid mechanics and their application to problems in engineering.

Syllabus:

- 1 Fluid Mechanics in Engineering and Nature
- 2 Basic Notions
- 3 Fluid Statics
- 4 Basic Equations in Integral Form
- 5 Basic Equations in Differential Form
- 6 Introduction to Computational Fluid Dynamics (CFD)
 - Tesla Valve Design Project
- 7 Dimensional Analysis and Similitude
- 8 Internal Incompressible Flows
- 9 External Incompressible Flow ** (if time permits).

Grading

HW	25%	Assigned weekly; Solutions posted on Courseworks.	
Tesla Project	10%	Due Dec 22, 2022 (Thu)	
Midterm 1	20%	Oct. 6; Lecture hours; Mudd 303	Closed book & notes. Might include some extra credit and conceptual questions.
Midterm 2	20%	Nov. 10; Lecture hours; Mudd 303	
Final Exam	25%	Dec. 20; Lecture hours; Room TBA	

Late HW Policy: HW is due on the date posted on Courseworks and should be uploaded in the form of pdf. Late HW will not be accepted unless special accommodation has been arranged with the instructor ahead of time.

Requesting Re-grading

You have one week from the day the graded exams and HWs are turned back to you, to discuss any possible re-grading. After that period, re-grading requests will not be considered.

Assignments, Readings, Solutions, Grades, etc.

Will be posted on the Courseworks site.

Laptop/Cellphone/Tablet Use: Use of these devices in class is permitted only if it is directly connected with the class (such as taking notes, viewing handouts, checking Courseworks, etc.). Please refrain from using these devices for any other purposes during class. Cellphone ringers should be turned off during class.

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. While seeking help/advice in clarifying underlying concepts is OK, collaboration on HW assignments/projects, unless specifically allowed by the instructor, is NEVER OK.

You can find more information about university misconduct policies on the web at these sites:

<https://www.cc-seas.columbia.edu/integrity>

<https://www.cc-seas.columbia.edu/integrity/policy>

Personal Wellbeing

- If you are sick, in particular with an illness that may be contagious, notify me by email but do not come to class. Please refer to the university attendance policy document (updated Aug 23, 2022) for absences and missed classes due to infectious diseases (such as COVID-19, influenza, and Monkeypox) <https://bulletin.columbia.edu/sipa/academic-policies/attendance-policies/?jump=0>
- All students with disabilities who require accommodations for this course should contact me at their earliest convenience to discuss their specific needs. If you have a documented disability, you must be registered with Columbia Health Disability Services (<https://www.health.columbia.edu/content/disability-services>) to receive accommodations.
- If you are struggling with anxiety, stress, depression, or other mental health-related concerns, please consider visiting the Columbia Health Counseling Services. If you are concerned about a friend, please encourage that person to seek out our services. <https://www.health.columbia.edu/content/counseling-and-psychological-services>