Applied Physics 4340: Fluid and Continuum Physics

Spring term, 2022

Instructor: Dr. Lisa Wickham, 233 Clark, lw45@cornell.edu.

Office hours: TBD– see Canvas, which will often have a Zoom link for a Thursday evening remote session and announce in person office hour time on Friday. Also catch me at end of class.

Lecture: MWF 11:15am in Malott Hall 207

Recitation: Wednesday 12:20pm, in Rockefeller Hall 105

Co-instructor: Scott Heinekamp, swh6@cornell.edu

main text:

Frank M. White, *Fluid Mechanics, 9th edition*, McGraw Hill.

(The paperback SI edition can be cheap and avoids American units.)

starting text (which we will focus on during the first week):

John R. Taylor, *Classical Mechanics*, University Science Books 2005.

online text available through the Cornell Library (can occasionally supplement main text)

Pijush K. Kundu, Iran M. Cohen, David R. Dowling, Gretar Tryggvason *Fluid Mechanics*, 6th edition, Academic Press 2016.

Participation credit worksheets: During most recitations and some classes we'll go through worksheets together. Canvas upload your real attempt by assignment deadline for typically 1 participation point each.

Homework: The first short assignment will be due by 5pm Friday Jan 24 (through an "Assignment" upload link on Canvas). I anticipate that there will be roughly weekly homeworks, with gaps for the midterm and for the intense part of the paper writing. Late work may get up to 80% credit up to the late Canvas deadline (i.e. the end of the link availability), which will typically be a few days after the normal deadline for that assignment.

You are welcome to discuss the homework with each other, but you MUST turn in your own clearly DISTINCT writeup. This writeup must include some of your own words of explanation and must be different from any other answer. I estimate that the total homework grade will be worth around 30% of the course grade.

Paper of limited scope: My vision is for you to pick a fluid mechanics area not part of this class and cover material appropriate for about a first lecture in that subtopic. Aim it at your classmates – two of them will give anonymous feedback on the first draft. Keys will be clarity of explanation of that section of derivation, appropriate use of more than 1 reference in arriving at your OWN explanation, a short introductory section that gives context and hopefully initiates interest, and a concluding section explaining qualitatively how the ideas in the paper relate to some further accomplishments of fluid mechanics. This is in part an exercise in good technical writing. I estimate the final paper will be about 15% of the final grade, and I'll offer some possible topics and references around midterm time. After that you'll pick a topic&some references and draft an introduction as a step before a complete rough draft to be peer reviewed, and you'll hand in a final paper version during the exam period project date.

Exams: I plan to hold an evening midterm exam on Thursday March 23. There will be **at least** one quiz of modest weight. A tentative distribution is that together the midterm and any quizzes will be about 42% or so of the course grade, and the midterm will have the majority of that weight. Then about 13% of the grade would be for class participation, including doing worksheets in class&recitation, completing tasks related to paper development, asking questions, etc.

Some topics likely to be included in this course:

Intro to elasticity, especially stress and strain tensors

Intro to fluid properties and descriptions

Some hydrostatics

Conservation laws using integrals for a control volume – with engineering problems!

Differential versions of conservations laws

The stream function and vorticity

Dimensional analysis

Introduction to viscous flow in pipes

Some treatments useful for turbulence

Flow past objects (boundary layers, drag, lift)

Idealized potential flow (e.g. outside boundary layers – especially helpful for lift)

Instability

If there's extra time: brief introduction to compressible flow (i.e. gases at high speeds)