ME 437/PHY 457/TME437: Incompressible Flow Fall 2019

Instructor: Hussein Aluie email: hussein*&At**rochester.edu
Hopeman 406 phone: 585-276-7170

Office Hours: MW 4:45pm-5:30 pm and F 2-3pm, or by appointment

Class: MW 3:25 – 4:40 pm Hylan 206

Blackboard:

Any student registered for the class should have access to Blackboard. I will use it to communicate important information about the course.

Course Webpage:

http://www.complexflowgroup.com/courses/Fall%202019/ME437

The course webpage has office hours for TAs and instructor, HW due dates, Exam dates, syllabus, etc. ....

Co-Instructors:

Dr. Benjamin Storer (benjamin.storer*&At**rochester.edu)

Prerequisite Courses:

The following courses or their equivalent: ME 225, ME 201 or ME 400.

Texts:

An Introduction to Fluid Dynamics
by PK Kundu, IM Cohen, and DR Dowling (any edition)

The textbook can be obtained from the university Bookstore or as an e-text from the UofR Online Library system. The book is well-rounded and covers most topics covered in the course. You are encouraged to complement your reading with any of the following alternate references which are on reserve at the Carlson Library:

- *An Introduction to Fluid Dynamics* by GK Batchelor
- *Incompressible Flow* by RL Panton
- *Viscous Fluid Flow* by FM White
- *Div, Grad, Curl, and All That: An Informal Text on Vector Calculus* by HM Schey

If you have not had an undergraduate course in fluid dynamics, you can consult any the standard undergraduate texts. You are also encouraged to audit the undergraduate course, ME 225, this fall. The textbook for ME 225 is also on reserve:

A Brief Introduction to Fluid Mechanics by Young, Munson, Okiishi, and Huebsch

Course Outline: The study of incompressible flow covers fluid motions which are gentle enough that the density of the fluid changes little or none. Topics: Conservation equations. Bernoulli's equation, the Navier-Stokes equations. Inviscid flows; vorticity; potential flows; stream functions; complex potentials. Viscosity and Reynolds number; some exact solutions with viscosity; boundary layers; low Reynolds number flows. Waves.

Course Material is subject to change, but will likely cover the following, time permitting:

1) Introduction (Ch.1)
2) Cartesian Tensors (Ch.2)
3) Kinematics (Ch. 3)
4) Conservation Laws and Equations of Motion (Ch. 4)
5) Laminar Flow (Ch. 9)
6) Vorticity Dynamics (Ch. 5)
7) Potential (Ideal) Flow (Ch. 7)
8) Computational Fluid Dynamics (Ch. 6)
9) Boundary Layers (Ch. 10)
10) Instability (Ch. 11)
11) Turbulence (Ch. 12)

Grading: There will be (i) assignments approximately every two weeks, (ii) an in-class exam toward the end of the semester, and (iii) a Term paper + presentation. Each will account for 1/3-rd of your final grade.

Homework: There will be approximately 7 homework assignments, posted on Blackboard. Tentative due dates can be found on the course webpage (subject to change). Although you may discuss homework problems with me, teaching assistants, or your classmates, you are expected to work out the problems independently (see Academic Honesty).

A working knowledge with Python, Matlab, or Mathematica may be helpful for some problems, especially ones requiring plots or visualization. These need to be clearly labelled, with axes, colorbars, and titles.

You are encouraged to type your assignments, or at least portions of it, to familiarize yourself with typesetting software such as LaTeX or MS Word's Equations editor, and should be able to include figures and captions in your reports. These are necessary skills for PhD students who plan to publish papers.

Solutions to completed assignments will not be made available. However, you are encouraged to discuss your graded assignment with the instructor or TA. Although you may discuss homework problems with instructor, teaching assistants, or your

classmates, you are expected to work out the problems independently (see Academic Honesty).

Academic Honesty: http://www.rochester.edu/college/honesty/
You may discuss homework problems with others, but you must **not retain** written notes from your conversations with other students, or share data electronically (e.g. files, emails, etc …) to be used in completing your homework. Your written work must be completed without reference to such notes, with the exception of class and recitation notes.