Jan 18, 2021 - Course Outline

MECH 539 - Advanced Fluid Mechanics

Spring 2021 - 3 credits

Instructor: Dr. A.P. Yalin
Lectures: Tuesdays (T) and Thursdays (R), 9:30 – 10:45 am, Engineering B3 -- for In Person students
Email: azer.yalin@colostate.edu
Office Hours: R 11am-12pm, A103P (Note: Please let me know in lecture if you plan to come.)

Readings and Materials:
-Class notes will be provided by the instructor. These notes will be partially completed, for students to fill in during lectures, and will be provided through Canvas as OneNote or pdf.
-Supplemental course material reference website:
https://web.stanford.edu/~cantwell/AA210A_Course_Material/AA210A_Course_BOOK/
https://web.stanford.edu/~cantwell/AA210A_Course_Material/AA210A_Lectures/
-Recommended text-book: Incompressible Flow, by R.L. Panto, Wiley Edition: 4th
ISBN-13: 978-1118013434; ISBN-10: 9781118013434

Main Topics by week (Schedule may flex to cover specific content; Chap #s from Cantwell):

1. Chapter 1: Introduction to fluid flow **(Jan 18-)**
2. Chapter 2: Thermodynamics **(Jan 25-)**
3. Chapter 3: Control volumes, vector calculus **(Feb 1-)**
4. Chapter 4: Kinematics of fluid motion **(Feb 8-)**
5. Chapter 5: The conservation equations **(Feb 15-)**
6. Chapter 6: Forms of equation of motion; Potential and stream functions **(Feb 22-)**
7. Chapter 7: Entropy generation and transport; Vorticity dynamics **(March 1-)**
8. Homework review; Midterm **(March 8-)**
9. Special Topics **(March 15-)**
10. Chapter 8: Viscous flow along a wall **(March 22-)**
11. Cont'd: Chapter 8: Viscous flow along a wall **(March 29-)**
12. Chapter 9: Quasi-one-dimensional flow **(April 5-)**
    Spring Break: April 12-
13. Chapter 10: Gas-dynamics of nozzle flow **(April 19-)**
14. Chapter 12: Steady Waves in Compressible Flow **(April 26-)**
15. Review and Overflow **(May 3-)**

Course Objectives:
At the end of the course, students will be able to:
(1) use mathematical tools of vector and tensor analysis for analysis of fluid mechanics problems
(2) implement control volume techniques to estimate unknowns of interest concerning mass, momentum, and energy in fluid flows
(3) implement differential equation conservation techniques to problems in fluid mechanics
(4) employ specific knowledge of fluid mechanics and flow physics to problems related to viscous flow along a wall, quasi 1-D flow, gas dynamics of nozzle flow, area change (including wall friction and heat transfer), and waves in compressible flow.

Grading:
Homework 25%, Midterm 30%, Final Exam 45%
Midterm: TBD near March 12
Final Exam: TBD

Homework Assignments:
~6 Homework Sets: Assigned on approximately biweekly basis starting from second week. These will be submitted electronically through Canvas. There will be a 20% per day late penalty (beginning at 9:30 am of the due date). Students can work these homeworks in small groups (up to 3 people) but the homeworks must be turned in individually as your own work.

Skills Required for Being Successful In this Class:
Physical understanding of fundamentals in fluids
Kinematics, thermodynamics, conservation laws, etc.
Strong logical analysis and engineering mind
Making valid assumptions, control volume theory, optimization, etc.
Strong mathematical skills

Vector Calculus (example)
Partial Differential Equations (PDEs)
Etc.