ChE 211A (3-0-0-0(9))

Fluid Mechanics and its Applications

Instructor: Rahul Mangal, FB 451, mangalr@iitk.ac.in

Class Email: che211a.iitk@gmail.com

TAs:

- Karnika Singh (karnika@)
- Harishwar (harishwar20@)
- Keerthi Vasan (keerthi21@)
- Ankit Sharma (sankit21@)
- Panjak Sonkar (pankajs21@)
- Fateh Bahadur (fatehb21@)

Timings

- **Lectures:** M W F at 10-11 AM in L16
- There will not be any separate discussion hour. However, those who have doubts can visit the instructor's office every Tuesday 5-6 PM.

Evaluation and Grading Policy

- Relative Grading
- Class Attendance (5%): Attendance in lectures is compulsory. Less than 75% lecture attendance will disqualify you from appearing in the end-semester examination. 25% is for unforeseen exigencies such as an illness, family occasions, participation in Institute events, etc. with a valid medical certificate, prior SUGC-approved leave etc. No exceptions will be entertained. Anytime your attendance falls below 25% you may be de-registered from the course.
- Homework Assignments: Will be sent periodically, but students are expected to continuously practice problems on their own. Assignments need not be submitted.
- Quizzes (25%): 2-3 surprise quizzes.
- Mid-Semester Exam (30%): 2 hr exam on a pre-announced date.
- There will not be any makeup for the quizzes or Mid-sem.
- End-Semester Exam (40%): 3 hr exam on a pre-announced date. Appearing in the End-sem exam is mandatory to get a passing grade.

Course Policies

- All efforts will be made to conduct this course smoothly. In case of any ambiguity, the instructor's decision will be final.
- Plagiarism of any form (from other individuals/web/books etc.) anywhere will not be tolerated and will lead to an "F" grade. You are free to discuss and learn from each other, but your quiz/exam should be your own original work.

Course Contents

- **Introduction**: Fluid, fluid types, continuum hypothesis, viscosity, velocity, and stress fields.

- **Fluid Statics**: Pressure distribution, hydrostatic forces on submerged plane surfaces
- **Kinematics**: flow visualization - streamlines, pathlines, streakline, timelines.
- **Integral/Macroscopic balances**: Control volume, Conservation of mass, energy and linear momentum. Application of macroscopic balances.
- **Differential balances**: Differential equations of mass conservation, differential equations of linear momentum, Navier-Stokes equations. Application of differential balances.
- **Dimensional analysis and similarity**: Buckingham Pi theorem, dimensionless numbers.
- **Pipe/Duct flows**: Laminar vs turbulent flows, head loss, friction factor, Moddy chart, hydraulic diameter, losses.
- **Flow meters**: Pitot tube, venture, orifice, rotameter.
- **Flow past immersed bodies**: Creeping flow, Inviscid flow Bernoulli equation, boundary layer, drag on flat plate for laminar flow, drag on immersed bodies.
- **Flow through packed and fluidized beds**: Kozeny-Carman equation, Ergun equation, Fluidization, particle settling.

If time permits, then some of the following topics will also be discussed:

- **Mechanical operations**: Filtration, Centrifuges and cyclones, Mixing and agitation.
- **Flow machinery**: Pumps, efficiency, cavitation.

Reference Books

1. Fluid Mechanics, by F. M. White (McGraw Hill 8th edition)
2. Introduction to Fluid Mechanics, by R. W. Fox, Alan T. McDonald and Philip J. Pritchard (Wiley, 8th edition)
3. Fluid Mechanics and Its Applications by V. Gupta and S. K. Gupta (New Age International Publishers, Second Edition)