Fluid Mechanics (ME 201)

Instructor: Dr. Sudhakar Yogaraj

School of Mechanical Sciences, IIT Goa.

Course contents

- Introductory concepts: Definition of fluid, Newton's law of viscosity, continuum hypothesis, properties of fluids, non-Newtonian fluids
- Fluid statics: Pascals law, hydrostatic pressure distribution, manometer, hydrostatic force on a submerged plane & curved surfaces, buoyancy, stability of submerged & floating bodies
- Kinematics: Lagrangian & Eulerian description, steady and uniform flows, acceleration, streamline, pathline and streakline, motion and deformation of a fluid particle, vorticity
- Governing equations in integral form: Reynolds transport theorem, conservation of mass, momentum and energy, Bernouli's theorem
- Dimensional analysis: principle of dimensional homogeneity, Buckingham Pi theorem, method of repeating variables, non-dimensional numbers, physical similarity, incomplete similarity
- Governing equations in differential form: derivation of continuity equation and its alternative form, stream function, conservation of momentum (Cauchy equation), constitutive law for Newtonian fluids, Navier-Stokes equations, exact solutions to specific problems
- Flow through pipes: laminar & turbulent flows, Reynolds dye experiment, entrance & fully developed region, Hagen-Poiseuille flow, transition, Darcy friction factor, Moody diagram, Colebrook and Harrland approximations, minor losses, flow measurement techniques
- Boundary layers: D'Alemberts paradox, idea of boundary layer, BL thickness, BL equations, Blasius solution, momentum integral technique, flow separation, lift & drag acting on immersed solid bodies

References

1. YA Cengel, JM Cimbala, *Fluid mechanics*, McGraw Hill Publishers.
2. RW Fox, PJ Pritchard, AT McDonald, *Introduction to fluid mechanics*, John Wiley & Sons.
3. FM White, *Fluid mechanics*, McGraw Hill Publishers.
4. SK Som, G Biswas, S Chakraborty, *Introduction to fluid mechanics and fluid machines*, McGraw Hill publishers. (Discussions are slightly advanced)

Grading policy

- 8 quizzes (each 10% and best 6 out of 8) – 60%
- Mid-sem exam – 20%
- End-sem exam – 20%