ME210 Fluid Mechanics

Credit: 2.5-0.5-0-3 Approval: Approved in 3rd Senate

Students Intended For: Undergraduate Elective or Core**:** Core

Course Objective:

This course is an introductory course in fluid mechanics. It begins by asking the question what constitutes a fluid. In the first part the continuum concept, various classifications of fluids are discussed. The second part introduces concepts of statics, kinematics and dynamics of fluids and underlying governing equations. Finally, solutions to various problem involving internal pipe flows and external flows are treated in the third part. Concepts of compressible flow and computational fluid dynamics are introduced at the end of the course. The course also gives an opportunity to learn various methods in EXCEL and MATLAB to solve simple flow problems.

Course Content:

1. **Introduction:** definition of fluid, liquids and gases, continuum hypothesis, compressible and incompressible fluid/flow, viscosity, stress field, Newtonian and non-Newtonian fluids **6 hrs**
2. **Fluid Statics:** Pascal's law, hydrostatic pressure, standard atmosphere, manometry, center of pressure, forces on partially and fully submerged bodies, buoyancy, metacentric height, stability, rigid body motion. **6 hrs**
3. **Fluid Kinematics:** Lagrangian and Eulerian description of fluid motion, elementary flows, vorticity and circulation, flow lines, stream lines, stream functions, rotational and ir-rotational flows, flow visualization. **6 hrs**
4. **Fluid Dynamics:** Newton's second law, fundamental equations of mass, momentum and energy, Reynolds transport theorem, Integral formulation of governing equations, differential formulation, Euler's equation, Bernoulli's equation, Navier-Stokes equation. **8 hrs**
5. **Internal Flows: f**ully developed flow, Couette Flow, Hagen-Poiseuille flow, flow through ducts, channels, Venturi, Orifice, flow measurements, friction factor and head loss calculations, Moody's chart, open-channel flow **8 hrs**
6. **Dimensional Analysis:** scaling and similarity, similitude and dimensional analysis, Buckingham π – theorem, non-dimensional parameters, model testing. **4 hrs**
7. **External Flows:** Boundary layer flows, flow over an aerofoil, flow over a cylinder and sphere, laminar and turbulent flows, flow separation, lift and drag, D'Alembert paradox, von Karman integral equation, displacement and momentum thickness. **4 hrs**

Text Books:

1. Fox and Mc Donald, *Introduction to Fluid Mechanics*, 7th Edition, John Wiley, 2009.
2. White FM, *Fluid Mechanics*, 6th Edition, Tata McGraw Hill, 2007.

Reference Books:

1. Yuan SW, *Foundations of Fluid Mechanics*, 2nd Edition, Printice Hall, 1988.
2. Streeter VL, Wylie EB and Bedford KW, *Fluid Mechanics*, 9th Edition, McGraw Hill, 1998.