Course Type	Course Code	Name of Course	L	T	P	Credit
DC	MEC 202	Fluid Mechanics	3	0	0	9

Course Objective

- To understand the kinematics and dynamics of fluid motions.
- To understand the governing equations dictating various types of flow problems.
- To develop an idea on the effects of pressure (and its gradient), viscosity, fluid stress, strain rate and their mutual relationship.

Learning Outcomes

Upon successful completion of this course, students will:

- Understand the kinematics and dynamics of fluid motions as opposed to deformable solids.
- Develop a first-hand understanding of various types of flow problems: potential, irrotational, inviscid, viscous, incompressible and compressible.
- Understand the logic behind the derivations of Bernoulli's, Euler's and Navier-Stokes Equations governing specific fluid flows.
- Develop a clear understanding of the constitutive relationship between stress and strain rate for fluid motions.
- Develop a clear understanding of Boundary Layer Approximations and Boundary Layer Theory.
- Develop the understanding on the importance and application of Dimensional and similarity Analysis.
- Develop an understanding on the laminar and turbulent flows.

Module	*Topics*	Lectures	Learning Outcomes
1	**Fluid and their properties:** Concept of fluid, difference between solids, liquids and gases; ideal and real fluids; properties of fluid, Newtonian and non-Newtonian fluids.	3	Develop concepts of fluids as opposed to deformable solids, Understanding of characteristics of various types of fluids: Their mutual similarities and differences.
2	**Fluid Statics:** Pressure and its measurement, Pascal's law and its engineering applications, Hydrostatic force on a plane and curved submerged surfaces, resultant force and center of pressure, Buoyancy and flotation, stability of floating and submerged bodies, metacentric height and its determination, pressure distribution in a liquid subjected to constant horizontal/ vertical acceleration, rotation of liquid in a cylindrical container.	6	Develop the ideas of pressure and hydrostatic force. Understanding the cause of Buoyancy and its effects on floating objects and their stability.
3	**Fluid Kinematics:** Classification of fluid flows, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration, streamline, path line and streak line, continuity equation; Rotational flows, rotation velocity and circulation, stream and velocity potential functions, flow net.	6	Develop in-depth ideas of kinematics of fluid flows for various types of flow problems. Understand difference between streamlines/ path lines and streak lines. Develop understanding of the kinematics of the vorticity and potential flows.
4	**Fluid Dynamics:** Reynolds Transport Theorem, Euler's equation, Bernoulli's equation and steady flow energy equation; applications of Bernoulli's equation, Siphon, Venturimeter, Orificemeter, impulse momentum equation, flow along a curved streamline, free and forced vortex motions	6	Understanding of how various fluid-dynamical equations is derived. Understand the application of Bernoulli's Equation to specific flow problems. Understand the Impulse-Momentum equation for flows around curved boundaries (This idea is essential for understanding the future course on Fluid Machines (MEC204)).

5	**Boundary Layer Flow:** Navier-Stokes equation, Boundary layer concept, displacement, momentum and energy thickness, Von-Karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate	6	Develop an understanding of Boundary Layer approximation and various aspects of boundary layer flows.
6	**Viscous Flow:** Relationship between shear stress and pressure gradient, flow through pipes, flow between two parallel plates; Kinetic energy and momentum correction factor.	6	Develop an understanding on the effects of flow viscosity, fluid stress and the constitutive relationship between stress and strain rate.
7	**Dimensional Analysis and Similitude:** Fundamental and derived units and dimensions, dimensional homogeneity; Rayleigh's and Buckingham's Pi method for dimensional analysis; Dimensionless numbers and their significance; model studies.	3	Develop an understanding on the Dimensional Analysis and Similitude and their applications in solving various fluid-flow problems.
8	**Flow Through Pipes:** Major and minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes.	6	Develop an understanding on the laminar and turbulent flows through pipes and various kinds of subsequent losses due to friction.

Text Book:

1. Introduction to Fluid Mechanics by Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, Wiley, 2009

Reference books:

1. F.M. White, Fluid Mechanics, McGraw-Hill (India) Ltd., 8th edition
2. Fluid Mechanics, Kundu and Cohen, Academic Press.
3. Foundations of Fluid Mechanics by Shao Wen Yuan, Prentice-Hall Publications.
4. S.K. Som and G. Biswas, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, 3rd edition.