Course No	Course Name	L-T-P-Credits
MA 410	**Fluid Mechanics**	**3-0-0: 0**

Prerequisite: NIL

Course Objectives: The objective of the course is to introduce the fundamental concepts of fluid mechanics, properties of fluids and their kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equation, and momentum equation. Also introduces the concept of flow patterns and viscous flow through ducts and their corresponding problems.

Course Outcomes: After successful completion of the course, students will be able to:

1. Understand the concept of fluid, its properties, types of fluid and forces acting on fluid elements.
2. Apply Lagrangian and Eulerian methods for describing fluid motion.
3. Use the concept of stream and potential functions to describe a flow field.
4. Analyse stresses in fluid motion and relation between stress and rate of strain.
5. Derive the fundamental equations of fluid dynamics.
6. Know the basic concept of boundary layer flow.

SYLLABUS

Module	Contents	Hours
I	**Introduction:** Concept of fluid; difference between solids, liquids and gases; concept of continuum; density, specific volume, specific weight, specific gravity, viscosity, vapour pressure, compressibility, bulk modulus, surface tension and capillarity; shear stress, Newtonian and non-Newtonian fluids.	6
II	**Fluid Statics:** Forces on fluid elements, Pascal's law, pressure distribution in static fluid, hydrostatic forces on plane surfaces.	3
III	**Fluid Kinematics:** Description of flow fields, steady and unsteady flows, uniform and non-uniform flows, laminar and turbulent flows; Lagrangian and Eulerian methods of description; stream lines, streak lines and path lines; velocity, acceleration and circulation; stream function, velocity potential and vorticity.	9

IV	**Fluid Dynamics:** Equation of continuity, Euler's equation of motion, Bernoulli's equation, momentum equation, integrals of Euler's equations of motion.	8
V	**Viscous Flows:** Viscous Flows: Stress analysis in fluid motion, relations between stress and rate of strain, Couette flow, Hagen-Poiseuille flow, Navier-Stokes equations, diffusion of vorticity, dissipation of energy, steady motion of a viscous fluid between two parallel plates, steady flow through cylindrical pipes, Reynold's number, Concept of boundary layer.	10

Essential Readings:

1. F. M. White, "*Fluid Mechanics*", McGraw-Hill Education (India) Pvt. Ltd, 8th edition, 2015.
2. F. Chorlton, "*Textbook of Fluid Dynamics*", CBS Publisher, 2004.

Supplementary Readings:

1. L. M. Milne-Thomson, "*Theoretical Hydrodynamics*", Dover Publications, 2011.
2. S. K. Som, G. Biswas and S. Chakraborty, "*Introduction to Fluid Mechanics and Fluid Machines*", McGraw-Hill Education (India) Pvt. Ltd, 3rd edition, 2017.
3. G. K. Batchelor, "*An Introduction to Fluid Dynamics*", Cambridge University Press, 2005.