

FLUID MECHANICS

Lectures / Tutorials : 4 / 1 Periods/Week

Sessional marks : 40

Semester End Exam. : 3 Hours

Semester End Exam. marks : 60

Credits : 4

Course objectives:

- To explain the units of measurement, properties of fluids and types of fluids.
- To introduce concepts, principles, laws, observations, and models of fluids at rest and in motion.
- To determine the pressure variation in static fluid on different surfaces.
- To understand the stability criteria of submerged and floating bodies.
- To derive basic equations and their applications.
- To analyze flow rates, velocities, energy losses, and momentum fluxes for fluid systems.
- To learn methods for computing head losses and flows in simple pipes.
- To estimate the efficiency of power transmission by pipe line.
- To estimate the friction factor for smooth and rough pipes.

Course objectives:

By the end of the course fluid mechanics, the students will be able to:

- To understand the basic principles governing the dynamics of non-viscous fluids
- To be able solve kinematics problems such as finding particle paths and stream lines.
- To be able to apply Bernoulli's theorem and the momentum integral to simple problems.
- To provide capabilities in estimating discharge and to find forces for design of hydraulic structures.

UNIT – I

Introduction

Dimensions and units – Physical properties of fluids- specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion

Fluid Statics

Variation of static pressure; Absolute and gauge pressure; Pressure measurement by manometers; Pressure on plane surfaces and curved surfaces.

Buoyancy

Buoyancy; Stability of submerged bodies and floating bodies; Metacentre and metacentric height.

UNIT – II

Fluid Kinematics

Methods of describing fluid motion; Classification of flows; Steady, unsteady, uniform and non-uniform flows; Laminar and turbulent flows; One, two and three dimensional flows; Irrotational and rotational flows; Streamline; Path line; Streak line; Equation for acceleration; Convective acceleration; Local acceleration; Continuity equation; Velocity potential and stream function; Flow net; Vortex flow – free vortex and forced vortex flow.

Fluid Dynamics

Euler's equation of motion; Bernoulli's equation; Energy correction factor; Momentum principle; Applications of momentum equation- Force exerted on a pipe bend.

UNIT – III

Flow Measurement In Pipes

Discharge through venturi meter; Discharge through orifice meter; Discharge through flow nozzle; Measurement of velocity by pitot tube.

Flow Through Orifices And Mouthpieces

Flow through orifices; Determination of coefficients for an orifice; Flow through large rectangular orifice; Flow through submerged orifice; Classification of mouthpieces; Flow through external and internal cylindrical mouthpiece.

Flow Over Notches And Weirs

Flow through rectangular, triangular and trapezoidal notches and weirs; End contractions; Velocity of approach; Broad crested weir.

UNIT – IV

Analysis of Pipe Flow

Laws of Fluid friction – Darcy's equation, Minor losses – pipes in series – pipes in parallel – branched pipes; Total energy line and hydraulic gradient line, Hydraulic power transmission through a pipe; Siphon; Water hammer.

Laminar Flow

Reynold's experiment; Characteristics of laminar flow; Steady laminar flow through a circular pipe (Hagen Poiseuille equation).

Turbulent Flow in Pipes

Characteristics of turbulent flow, Hydro dynamically smooth and rough boundaries, Velocity distribution, Friction factor for pipe flow, Variation of friction factor with Reynolds number- Moody's chart.

NOTE:

Two questions of 12 marks each will be given from each unit out of which one is to be answered. Twelve questions of one mark each will be given from entire syllabus which is a compulsory question.

TEXT BOOK:

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P. N. Modi and S. M. Seth; Standard book house; New Delhi, 2009.

REFERENCE BOOKS:

1. Fluid Mechanics by A. K Jain, Khanna Publishers, 2008.
2. Fluid Mechanics and Hydraulic Machines by R. K. Bansal; 9th Edition, Laxmi Publications, 2011.
3. Fluid Mechanics by Streeter and Wylie, 9th Edition, Tata McGraw-Hill, 2010.

WEB REFERENCES:

www.nptel.iitm.ac.in