CIPC2003 FLUID MECHANICS (3-0-0)

Course Objectives:

1. Explain about fluid properties and pressure measurement.
2. Analyze hydrostatic forces on surfaces and study of buoyancy and flotation.
3. Revise basics of kinematics and dynamics of fluid flow.
4. Observe flow through pipes and computation of coefficients of orifices and mouthpieces.
5. Differentiate between laminar and turbulent flows through pipe.

Module-I

Properties of fluids: Fundamental definitions, Density, specific weight, specific volume, specific gravity, viscosity, vapor pressure, compressibility and elasticity, surface tension and capillarity.

Fluid pressure and its measurement: Fluid pressure at a point, variation of pressure in a fluid, Pascal's law, atmospheric absolute, gauge and vacuum pressure, measurement of pressure.

Module-II

Hydrostatic pressure on submerged surface: Total pressure and centre of pressure, total pressure on plane surface(horizontal, vertical, inclined, curved),centre of pressure on vertical and inclined plane surface, pressure diagram, practical application of total pressure and centre of pressure(in dam, gate and water tank)

Buoyancy and Flotation: Buoyancy, buoyant force and centre of buoyancy, metacenter and metacentric height, stability of submerged and floating body, determination of metacentric height(experimental and theoretical)

Module-III

Kinematics of fluid flow: Introduction, velocity of fluid particles, types of fluid flow, flow pattern, basic principle of fluid flow, continuity equation, acceleration of a fluid particle,rotational and irrotational motion, circulation and vorticity, velocity potential, stream function, streamlines, equipotential lines, flow net, its uses and limitations

Dynamics of fluid flow: Introduction,forces acting on fluid in motion,Euler's equation ofmotion,Bernoulli's equation of motion,Kinetic energy correction factor,Bernoulli's equation for acompressible fluid,pressure velocity relationship and its application (venture meter,orificemeter,nozzle meter),pitot tube,free liquid jet,vortex motion(free and forced)

Module-IV

Flow through pipes: Introduction, types of flow, laws of fluid friction(laminar flow and turbulent flow),Formulae for head loss due to friction in pipes(DarcyWeisbachequation,Chezy'sformula,Manning's formula, Hazen-William's formula),other energy losses in pipe,Hydraulic grade line and energy grade line,flow through long pipes, flow through pipes (series,parallel,equivalent,by-pass,branched,syphonic),time of emptying a reservoir through pipe, transmission of power through pipe, flow through nozzle at the end of pipe, water hammer in pipe

Orifices and mouthpieces: Introduction, classification of orifices, flow through an orifice, hydraulic coefficients (velocity, contraction and discharge), flow through large orifices, classification of mouthpieces

Module-V

Laminar flow through pipes:Introduction,relation between shear pressure gradient, steady laminarflow in circular pipe,laminar flow through inclined pipes,laminar flow through annulus, laminar flowparallel plates (both plates at rest, one plate at rest and other moving),variation of friction factor f forlaminar flow, laminar flow around sphere, measurement of viscosity(viscometer)

Turbulent flow through pipes: Introduction, shear stress, hydro dynamically smooth and roughboundaries, velocity distribution for turbulent flow in hydro dynamically smooth and rough pipes,criteria for smooth and rough pipes, velocity distribution for turbulent flow in terms of mean velocityfor smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes,criteria for hydrodynamically smooth and rough pipes,variation of friction factor for commercial pipes).

Course Outcome:

After completion of this course a student shall be able to:

- Explain about fluid properties and pressure measurement.
- Analyze hydrostatic forces on surfaces and study of buoyancy and flotation.
- Revise basics of kinematics and dynamics of fluid flow.
- Observe flow through pipes and computation of coefficients of orifices and mouthpieces.
- Differentiate between laminar and turbulent flows through pipe.

Text Books:

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P.N.Modi and S.M. Seth, Standard Book House.

Reference Books:

2. Fluid mechanics by A.K. Jain, Khanna Publishers.
3. Engineering Fluid Mechanics by K.L. Kumar, S. Chand & Co.
4. Fluid Mechanics by V.L. Streeter, MGH