FLUID MECHANICS

COURSE OBJECTIVE

To understand the basic concepts of fluid mechanics for undergraduate students in Civil Engineering. The course will begin with the fundamental concepts of fluid flow and proceed to cover various flow phenomena and approaches to analyse the flow phenomena. Some important applications shall also be covered.

COURSE CONTENT

UNIT I

Fundamental Fluid Properties: Engineering units of measurement, mass, density, specific weight, specific volume, specific gravity, surface tension, capillarity, viscosity, bulk modulus of elasticity, pressure and vapour pressure. **Fluid Statics**: Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, manometers, Forces on plane and curved surfaces (Problems on Gravity Dams and Tainter Gates), buoyant force, stability of floating and submerged bodies, relative equilibrium.

UNIT II

Kinematics and Dynamics of Flow: Introduction to basic lines - Streamlines, Streaklines, Pathlines. Various types of fluid flow. Velocity potential function, Stream function, Vorticity and Circulation, Flow net. Basic equations of fluid flow like Energy equation, continuity equation and momentum equation. Bernoulli's equation and its applications.

UNIT III

Laminar Flow and Turbulent Flow: Introduction to laminar & turbulent flow, Reynolds experiment & Reynolds number. Velocity distribution, Laminar and turbulent boundary layers and laminar sublayer, boundary layer concept, aging of pipes. Losses due to sudden expansion and contraction, losses in pipe fittings andvalves, concepts of equivalent length, hydraulic and energy gradient lines, siphon, pipes in series, pipes in parallel, branching of pipes. Concept of Water Hammer transmission of power.

UNIT IV

Open channels: Channel geometry and elements of channel section, velocity distribution, energy in open channel flow, specific energy, types of flow, critical flow and its computations, uniform flow and its computations, Chezy's and Manning's formulae, determination of normal depth and velocity, Normal and critical slopes, Economical
sections. Basic assumptions and dynamic equations of gradually varied flow, characteristics analysis and computations of flow profiles, rapidly varied flow hydraulic jump in rectangular channels and its basic characteristics, surges in open channels & channel flow routing.

UNIT V

Forces on immersed bodies: Types of drag, drag on a sphere, a flat plate, a cylinder and anaerofoil development of lift, lifting vanes, Magnus effect.

Fluid Machines: Turbines: Classifications, definitions, similarity laws, specific speed and unit quantities, Pelton-wheel turbine-their construction and settings, speed regulation, dimensions of various elements, Action of jet, torque, power and efficiency for ideal case, characteristic curves. Reaction turbines: construction & setting, draft tube theory, runaway speed, simple theory of design and characteristic curves, cavitation.

COURSE OUTCOME:-

- Knowledge of the basic concepts and principles of fluid mechanics.
- Ability to analyze fluid flow problems with the application of momentum and energy equations.
- Ability to distinguish between various types of fluid flow.
- Ability to find solutions to typical pipe flow problems
- Basic knowledge of hydraulic machines.

REFERENCES

- Modi & Seth , Hydraulics & Fluid Mechanics ,Rajson's Publication Pvt Ltd
- A K Jain, Fluid Mechanics: Including Hydraulic Machines, Khanna Publisher.
- Subramanyam,Fluid Mechanics & hydraulic machines - - Tata McGraw-Hill
- R.J.Garde , Engg Fluid Mechanics , SCITECH Publishers Pvt Ltd
- Merle C. Potter, David C. Wiggert, Bassam H. Ramadan, Mechanics of Fluid, Cengage Learning.
- John F. Douglas, J.M. Gasoriek, John Swaffield, Lynne Jack, Fluid Mechanics, Pearson Education.
- K.R. Arora, Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Pub.Distributors..
- Balchandran, Engg Fluid Mechanics, PHI Learning Pvt Ltd
- Ojha & Chandramouli , Fluid Mechanics & Machinery , Oxford University Press
- Fox, Mc Donald, Pritchard Fluid Mechanicas– Wiley India, New Delhi.
- Narsimhan S Fluid Mechanics –. – University Press, Mumbai.
- Ratnam Chanamala kothapalli A.V. Fluid Mechanics & Machniery I.K. International, New Delhi.
- Flow Through Open Channel -- Tata McGraw-Hill
- S K Som, G Biswas, Suman Chakraborty, Introduction to Fluid Mechanics & Fluid Machines, TMH Ed.

LIST OF EXPERIMENTS:-

1. To Verify Bernoull's equation.
2. To verify Impulse Imomentum equation.
3. To find out the terminal velocity of a spherical body in water.
4. Calibration and study of Venturimeter.
5. Determination of Cc, Cv, Cd of Orifices
6. Draw characteristics Curves of Pelton Wheel Turbine.
7. Draw characteristics Curves of Francis Turbine.
8. Draw characteristics Curves of Kaplan Turbine.
9. Calibration of Nozzle meter and Mouth Piece
10. Reynolds experiment for demonstration of stream lines & turbulent flow
11. Determination of metacentric height
12. Determination of Friction Factor of a pipe
13. Determination of coefficient of discharge for a broad crested weir & to plot water surface profile over weir