

**OBJECTIVES:**

- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

**UNIT I UNIFORM FLOW****9**

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Fundamental equations - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force - Critical depth and velocity.

**UNIT II GRADUALLY VARIED FLOW****9**

Dynamic equations of gradually varied and spatially varied flows - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method, Graphical method - Applications.

**UNIT III RAPIDLY VARIED FLOW****9**

Application of the energy equation for RVF - Critical depth and velocity - Critical, Sub-critical and Super-critical flow - Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation - Surges and surge through channel transitions.

**UNIT IV TURBINES****9**

Impact of Jet on vanes - Turbines - Classification - Reaction turbines - Francis turbine, Radial flow turbines, draft tube and cavitation - Propeller and Kaplan turbines - Impulse turbine - Performance of turbine - Specific speed - Runaway speed - Similarity laws.

**UNIT V PUMPS****9**

Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitations in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Flow separation conditions - Air vessels, indicator diagrams and its variations - Savings in work done - Rotary pumps: Gear pump.

**TOTAL (L:45+T:15): 60 PERIODS****OUTCOMES:**

- The students will be able to apply their knowledge of fluid mechanics in addressing problems in open channels.
- They will possess the skills to solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- They will have knowledge in hydraulic machineries (pumps and turbines).

**TEXT BOOKS:**

- Jain. A.K., "Fluid Mechanics", Khanna Publishers, Delhi, 2010.
- Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2002.
- Subramanya K., "Flow in open channels", Tata McGraw Hill, New Delhi, 2000.

**REFERENCES:**

- Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
- Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi, 2008.
- Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2008.
- Mays L. W., "Water Resources Engineering", John Wiley and Sons (WSE), New York, 2005