

**II Year - II Semester**  
**20CE4007**

**L T P C**  
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## **HYDRAULICS AND HYDRAULIC MACHINES**

### **Course Learning Objectives:**

- To study about uniform and non uniform flows in open channel and also to learn about the characteristics of hydraulic jump
- To introduce dimensional analysis for fluid flow problems
- To understand the working principles of various types of hydraulic machines and Pumps.

### **Course Outcomes:**

Upon successful completion of this course the students will be able to

- Solve uniform open channel flow problems.
- Solve non uniform open channel flow problems
- Apply the principals of dimensional analysis and similitude in hydraulic model testing.
- Understand the working principles of various types of hydraulic machines
- Select suitable pumps and turbines.

## **SYLLABUS**

### **UNIT I**

#### **Uniform Flow in Open Channels:**

Types of channels –Types of flows - Velocity distribution– Chezy's, and Manning's formulae for uniform flow – Most Economical sections, Critical flow: Specific energy-critical depth – computation of critical depth

### **UNIT II**

#### **Non-Uniform Flow in Open Channels:**

Steady Gradually Varied flow-Dynamic equation, Mild, Critical, Steep, horizontal and adverse slopes-surface profiles direct step method- Rapidly varied flow, hydraulic jump, energy dissipation.

### **UNIT III**

#### **Hydraulic Similitude:**

Dimensional analysis-Rayleigh's method and Buckingham's pi theorem-study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations.

### **UNIT IV**

#### **Basics of Turbo Machinery:**

Hydrodynamic force of jets on stationary and moving flat , inclined and curved vanes, jet striking centrally and at tip, velocity triangle at inlet and outlet, expressions for work done and efficiency.

## **UNIT V**

### **Hydraulic Turbines:**

Layout of a typical Hydropower installation –Heads and efficiencies - classification of turbines. Pelton wheel - Francis turbine – Kaplan turbine - working, working proportions, velocity diagram, work done and efficiency. Draft tube –surge tanks-unit and specific quantities, performance characteristics-geometric similarity-Cavitation.

### **Centrifugal Pumps:**

Pump installation details-classification-work done- Mano metric head-minimum starting speed-losses and efficiencies-specific speed,- performance of pumps-characteristic curves-NPSH- Cavitation.

**Reciprocating Pumps:** Introduction, classification, components, working, discharge, indicator diagram, work done and slip.

### **TEXT BOOKS:**

1. Open Channel flow by K. Subramanya, Tata McGraw Hill Publishers
2. A text of Fluid mechanics and hydraulic machines by R. K. Bansal, Laxmi Publications New Delhi
3. Fluid Mechanics by Modi and Seth, Standard book house.

### **REFERENCES:**

1. Fluid Flow in Pipes and Channels by G.L. Asawa, CBS
2. Fluid Mechanics and Machinery by C.S.P. OJHA, R. BERNDTSSON and P.N. Chandramouli, Oxford Higher Education.
3. Fluid Mechanics and Machinery by Md. Kaleem Khan, Oxford Higher Education.