

## FLUID MECHANICS AND HYDRAULIC MACHINES

**Course Code: 13CE1157**

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### Course Educational Objectives:

- ❖ To familiarize the students with fluid statics and fluid dynamics.
- ❖ To introduce the concepts of the working and design aspects of hydraulic machines like turbines and pumps and their applications.

### Course Outcomes:

- ❖ Student will be able to develop to gain basic knowledge on Fluid Statics, Fluid Dynamics, closed conduit flows, hydro-electric power stations.
- ❖ Student will be able to design various components of pumps and turbines and study their characteristics.

### UNIT-I

(12 Lectures)

#### FLUID STATICS: DIMENSIONS AND UNITS:

Physical properties of fluids – mass density, specific weight, specific volume, specific gravity, viscosity, surface tension, vapour pressure and their influence on fluid motion. Atmospheric pressure, gauge pressure and vacuum pressure, measurement of pressure – Piezometers, U-tube and differential manometers – mechanical pressure gauges.

#### FLUID KINEMATICS:

Stream line, path line and streak lines and stream tubes. Classification of flows ideal fluid and real fluid – steady and unsteady flows, uniform and non-uniform flows, laminar and turbulent flows, rotational and irrotational flows, equation of continuity for one-dimensional flows.

**UNIT-II****(12 Lectures)****FLUID DYNAMICS:**

Various forces acting on a fluid element- Euler's and Bernoulli's equation for flow along a streamline, momentum equation and its applications for pipe bend problem. Closed conduit flow – Reynolds number, Reynolds experiment – “Darcy –Weisbach” equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line – hydraulic gradient line, measurement of flow : Pitot tube, venturimeter, orificemeter and flow nozzle meter.

**UNIT-III****(12 Lectures)****HYDRO-ELECTRIC POWER STATIONS :**

types – concept of pumped storage plants – storage requirements, mass curve, estimation of storage capacity for a uniform demand, estimation of power developed from a given catchment area, heads and efficiencies.

**BASICS OF TURBO MACHINERY :**

Hydrodynamic force on jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**UNIT-IV****(12 Lectures)****HYDRAULIC TURBINES :**

Classification of turbines – Impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine – working principles, workdone, efficiencies, hydraulic design, draft tube theory, functions and efficiency.

**PERFORMANCE OF HYDRAULIC TURBINES:**

Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbines, cavitation, surge tank, water hammer.

**UNIT-V****(12 Lectures)****CENTRIFUGAL AND RECIPROCATING PUMPS:**

Classification working of centrifugal pump, work done – manometric head – losses and efficiencies – specific speed – pumps in series and

parallel – performance characteristic curves, NPSH. Working of reciprocating pumps, discharge, slip, percentage slip, Indication diagrams.

### TEXT BOOKS:

1. P.N. Modi and S.M. Seth “*Hydraulics, fluid mechanics and hydraulic machinery*”, 14th Edition, Standard Book House, New Delhi 2002.
2. R.K. Rajput “*A text book of Fluid Mechanics and Hydraulic Machines*”, 5<sup>th</sup> Edition, S.Chand & Company (Ltd) New Delhi, 2009.

### REFERENCES:

1. D.S. Kumar, “*Fluid Mechanics and Fluid Power Engineering*”, 2<sup>nd</sup> Edition, SK. Katania and Sons, 2010.
2. Dr. R.K. Bansal “*A Text book of Fluid Mechanics and Hydraulic Machines*”, 9<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2010.
3. A.K.Jain, “*Fluid Mechanics Including Hydraulic Machines*”, 8<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2003.

