

FLUID MECHANICS AND HYDRAULIC MACHINES

Course Code: 15CE1169

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Course Outcomes:

At the end of the course, Students will be able to

- CO 1** Use various fluid properties in the fluid flow problems and describe flowing of fluid
- CO 2** Apply the dynamic equations to study the behavior of flowing fluid in the practical problems and able to determine the various losses occurs in the fluid flow problems.
- CO 3** Determine the required hydro power for a given catchment and also able to determine the hydrodynamic forces exerted by the fluid jet on various surfaces.
- CO 4** Describe the functioning of various turbines and do the hydraulic design of the turbines and analyze the performance characteristics of various turbines.
- CO 5** Describe and determine the performance of centrifugal pumps.

UNIT-I

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

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, orifice meter.

UNIT-III

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

HYDRAULIC TURBINES:

Classification of turbines – Impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine – working principles, work done, efficiencies, hydraulic design.

PERFORMANCE OF HYDRAULIC TURBINES:

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

UNIT – V

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.

TEXT BOOKS:

1. P.N Modi and S.M. Seth, “*Hydraulics and Fluid Mechanics Including Hydraulic Machines*”, Standard Book House, 14th Edition, 2002.
2. R.K. Rajput, “*A Textbook of Fluid Mechanics and Hydraulic Machines*”, S.Chand & Company Ltd, New Delhi, 5th Edition, 2009.
3. Banga and Sharma, “*Hydraulic Machines*”, Khanna Publishers, New Delhi, 6th Edition, 1995.

REFERENCES:

1. D.S. Kumar, “*Fluid Mechanics and Fluid Power Engineering*”, S K Kataria and Sons, 2th Edition, 2010.
2. A.K.Jain, “*Fluid Mechanics Including Hydraulic Machines*”, Khanna Publishers, New Delhi, 8th Edition, 2003.
3. R.K. Bansal, “*A textbook of Fluid mechanics and hydraulic machines*”, Laxmi Publications (P) Ltd., New Delhi, 9th Edition, 2010.