2/4 B.Tech. THIRD SEMESTER

AE3T4 Fluid Mechanics and Hydraulic Machinery Credits: 4

Lecture: 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 periods/week **Semester end examination: 70 marks**

Objectives:

1. Knowledge of fluid mechanics is very much required for a mechanical engineering student as he needs the fluid mechanics in design of various hydraulic systems.
2. The subject knowledge will also be helpful for power calculations of hydraulic turbines.

Learning Outcomes:

At the end of course the student will be able to :

1. Describe the concepts of fluids and its properties, apply fluid mechanics equations in solving fluid statics such as finding pressure difference in manometers.
2. Express the concept of fluid flows, solve flow calculations in various types of pipes and apply equation of continuity of mass, energy and momentum equation for any analysis of dynamic problems.
3. Solve various velocity diagrams for stationary, moving and inclined cases of flat and curved blades of turbo machinery.
4. Report on the concepts of work done by fluid jets leading to generation of power and also identify the selection, governing and performance of turbines.
5. Analyze the functions of various hydraulic turbines and pumps with working proportions and efficiencies.

Pre- Requisites:
Engineering physics, Engineering Mechanics

UNIT-I
INTRODUCTION : Dimensions and units – Physical properties of fluids specific gravity, viscosity, surface tension, vaporpressure and their influences on fluid motionpressure at a point, Pascal's law, Hydrostatic law - atmospheric, gauge andvacuum pressure- measurement of pressure. Pressure gauges, Manometers: U-tube and differential Manometers.

UNTI – II
FLUID KINEMATICS:Description of fluid flow, Stream line, path line and streak lines and stream tube. Classification offlows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotationalflows – Equation of

continuityfor one, two, three dimensional flows – stream and velocity potential functions.
FLUID DYNAMICS:Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, Momentum equation and its application – forces on pipe bend. Vortex Motion- Free and Forced Vortices

UNTI – III
CLOSED CONDUIT FLOW: Laws of Fluid friction – Darcy's equation, Minor losses – pipes in series – pipes in parallel –Total energy line and hydraulic gradient line, Pipe network problems, variation of friction factor with Reynolds's number –Moody's Chart

UNTI – IV
MEASUREMENT OF FLOW: Pitot tube, Venturi meter and orifice meter – classification of orifices, flow over rectangular,triangular and trapezoidal and Stepped notches - Broad crested weirs.

UNTI – V
IMPACT OF JETS: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip – velocity triangles at inlet and outlet – expressions for work done and efficiency – angular momentum principle.

UNTI – VI
HYDRAULIC TURBINES: Classification- Pelton wheel- Reaction turbines- Inward and outward radial flow reaction turbines- Francis turbine- Axial flow reaction turbine- Kaplan turbine- Draft tube- Types- Theory- and efficiency of draft tube.

UNTI – VII
CENTRIFUGAL PUMPS: Main parts- Efficiency- Minimum speed for starting- Multi-stage centrifugal pumps- Specific speed of a centrifugal pump- Priming of a centrifugal pump- Characteristic curves- Main, Operational and constant efficiency curves- Cavitations- Effects- Cavitations in Hydraulic machines-NPSH.

UNIT VIII

RECIPROCATING PUMPS: Main parts- Classification-Discharge-Slip- Velocity and acceleration variation in suction and delivery pipes due to piston acceleration- Effect of variation of velocity on friction in suction and delivery pipes- Effect of acceleration in suction and delivery pipes on indicator diagram- Effect of friction- Maximum speed of reciprocating pump- Air vessels

Learning resources

Text Books:

1. P. N. Modi, Dr. S.M. Seth, “Hydraulics And Fluid Mechanics Including Hydraulics Machines”, Standard Book House, 2002
2. R.K.Bansal “A Textbook of Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, Ltd, 2005

References:

1. R.K.Rajput,“Fluid Mechanics and Hydraulic Machines”, S. Chand Limited, 2008
2. N.S.GovindaRao, “Fluid Flow Machines”, Tata McGraw Hill publishing company Ltd.
3. K.R.Arora, “Fluid Mechanics and Hydraulics and Hydraulic Machines”, Standard Publishers Distributors, 2005
4. JagadishLal, “Hydraulic Machines including Fluidics”, MPP, (1994)