ME3T3   FLUID MECHANICS AND HYDRAULIC MACHINES   Credits: 3

Lecture: 3 periods/week   **Internal assessment: 30marks**
Tutorial: 1 period/week   **Semester end examination: 70 marks**

Course objectives:
The objectives of the course are to enable students to:
- Demonstrate the fluid properties, fundamentals of fluid statics and fluid flow.
- Interpret the concepts of flow measurements and flow through pipes.
- Acquire knowledge of various turbines and pumps.

Course Outcomes:
Upon completion of this 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. Classify 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 analysis of dynamic problems.
3. Solve various velocity diagrams for stationary, moving and inclined cases of flat and curved blades of turbo machinery.
4. Distinguish various hydraulic turbines and pumps with working proportions and efficiencies.

Prerequisites: Engineering Mechanics

UNIT I
FLUID STATICS:
Dimensions and units: physical properties of   fluids- specific gravity, viscosity, surface tension and vapor pressure - Pascal's law, Hydrostatic law - Measurement of pressure: Piezometer, U-tube and differential manometers.
FLUID KINEMATICS:
Description of fluid flow, Stream line, path line, streak lines and stream tube.
Classification of flows: Steady, unsteady, uniform, nonuniform, laminar, turbulent, rotational and irrotational flows.

UNIT II
FLUID DYNAMICS:
Surface and body forces-Equation of continuity for one, two, three dimensional flows, Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.
CLOSED CONDUIT FLOW:
Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

UNIT III
MEASUREMENT OF FLOW:
Pitot tube, Venturimeter and orifice meter – classification of orifices, flow over rectangular, triangular, trapezoidal and stepped notches - Broad crested weirs.
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.

UNIT IV
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.
PERFORMANCE OF HYDRAULIC TURBINES:
Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine.

UNIT V
CENTRIFUGAL PUMPS:
Classification, working, work done – manomertic head - losses and efficiencies-specific speed- pumps in series and parallel - performance characteristic curves, NPSH.
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.

Learning Resource

Text books:

1. Hydrualics and Fluid Mechanics, by P.N.Modi and S.M.Seth, Standarard book house, 2000, New Delhi.
2. Fluid Mechanics and Hydraulic Machines, by Sukumar Pati, Mc Graw Hill Education Private Limited, 2014, New Delhi.

Reference books

1. Fluid Mechanics and Hydraulic Machines, by R.K.Bansal, Laxmi publications (P) Ltd., 2011, New Delhi.
2. Fluid Mechanics and Hydraulic Machines, by R.K.Rajput, S.Chand limited publications, 2008, New Delhi.
3. Fluid Flow Machines by N.S.Govinda Rao, Tata Mc Graw Hill publishing company Ltd.
4. Fluid Mechanics and Hydraulic Machines by K.R.Arora, Standard Publishers Distributors.
5. Elements of Hydraulic Machines & Fluids by Jagadish Lal, Metropolitan Book Co.