

HYDRAULICS AND HYDRAULIC MACHINES

Lectures / Tutorials : 4 / 1 Periods/Week

Sessional marks : 40

Semester End Exam. : 3 Hours

Semester End Exam. marks: 60

Credits : 4

Course objectives:

- To introduce the importance of study of open channel flow, to give brief description on different types of flows and channels and hydraulic design principles of channels.
- To learn the fundamentals of Uniform and Non-Uniform flow in open channels.
- To understand about the concepts of specific energy, critical flow and their applications.
- To give an idea about the gradually varied flow and rapidly varied flow and their equations and computations.
- To introduce the concepts of momentum principles.
- To impart the knowledge on pumps and turbines

Course outcomes:

By the end of the course hydraulics and hydraulic machines, the students will be able to

- To know the different types of flows and channels.
- To understand the performance of turbines and pumps.
- To know the applications of momentum principles.
- To make the student is expected to prepare models for prototypes of hydraulic structures.
- To make the student is expected to have thorough knowledge on the selection of turbines and pumps for practical purposes

UNIT – I

Open Channel Flow - Uniform Flow

Introduction, Classification of flows, Types of channels; Chezy, Manning's, Bazin, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels; Velocity distribution; Energy and momentum correction factors; Pressure distribution.

Open Channel Flow - Non - Uniform Flow

Concept of specific energy; Specific energy curves; Critical flow; Critical flow in a rectangular channel; Critical slope; Different slope conditions; Channel transitions- Reduction in width of channels, hump; Momentum principle applied to open channel flow; Specific force.

UNIT – II

Open Channel Flow - Gradually Varied Flow

Dynamic equation; surface profiles; Computation of surface profiles by single step method; Back water curves and Draw down curves; Examples of various types of water surface profiles.

Open Channel Flow - Rapidly Varied Flow

Hydraulic jump; Elements and characteristics of hydraulic jump; Types of hydraulic jump; Location and applications of hydraulic jump; Energy loss in a hydraulic jump.

UNIT – III

Momentum Principles

Action of jets on stationary and moving flat plates and curved vanes; Angular momentum principle;

Torque in roto dynamic machines.

Hydraulic Turbines

Classification; Impulse; Reaction; Radial, Axial, mixed and tangential flow turbines; Pelton, Francis turbines; Runner profiles; Velocity triangles; Head and efficiency; Draft tube theory; Similarity laws; Concept of specific speed and unit quantities; Selection of Turbines; Operational characteristics.

UNIT – IV

Centrifugal Pumps

Manometric head; Losses and efficiencies; Work done; Working Principle; Priming; Velocity triangles; Performance and characteristic curves; Cavitation effects; Similarity considerations.

Dimensional Analysis and Similitude

Dimensional homogeneity; Rayleigh's method; Buckingham π -method ; Geometric, Kinematic and Dynamic similarities; Reynold's, Froude, Euler, Mach and Weber numbers; Model laws; Scale effect; Distorted models.

NOTE

Two questions of 12 marks each will be given from each unit out of which one is to be answered. Twelve questions of one mark each will be given from entire syllabus which is a compulsory question.

TEXT BOOK

1. Hydraulics and Fluid Mechanics including Hydraulic Machines by P. N. Modi and S. M. Seth; Standard Book house, New Delhi, 2009.

REFERENCE BOOKS

1. Fluid Mechanics by A. K. Jain; Khanna Publishers, Delhi, 2008.
2. Flow in Open channels by K. Subramanya, 3rd Edition, Tata McGraw-Hill, 2008.
3. Fluid Mechanics and Hydraulic Machines by R. K. Bansal, 9th Edition, Laxmi Publications, 2011.

WEB REFERENCES:

www.nptel.iitm.ac.in

www.springerlink.com for e-journals