

HYDRAULICS AND HYDRAULIC MACHINERY

Course Code: 13CE1113

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Course Outcomes:

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

- CO 1** Outline the similarities between model and prototype and their relations
- CO 2** Explain the functioning of various turbines and their hydraulic designs
- CO 3** Analyse the performance of various turbines under different operating conditions and governing of turbines.
- CO 4** Determine the performance of centrifugal pumps under different operating conditions.
- CO 5** Designing of the most economical section and determination of hydraulic jump for energy dissipation at the downstream of irrigation structures

UNIT-I

(14 Lectures)

DIMENSIONAL ANALYSIS & SIMILITUDE:

Dimensional analysis-Rayleigh's method and Buckingham pi theorem-study of Hydraulic models-Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations.

BASICS OF TURBO MACHINERY:

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, Applications to radial flow turbines.

UNIT-II**(10 Lectures)****HYDRAULIC TURBINES-I:**

Layout of a typical Hydropower installation – Heads and efficiencies-classification of turbines-Pelton wheel-Francis turbine-Kaplan turbine-principle of working, working proportions, velocity diagrams, work done and efficiency, hydraulic design.

UNIT-III**(14 Lectures)****HYDRAULIC TURBINES-II:**

Draft tube – theory, functions and efficiency, modern developments in turbines, governing of turbines-Runaway speed of turbines–water hammer- surge tanks, Performance under unit head-unit quantities-specific speed - performance characteristics – Cavitation.

UNIT-IV**(14 Lectures)****CENTRIFUGAL PUMPS:**

Pump installation details-classification-work done- Manometric head-minimum starting speed-losses and efficiencies-specific speed - multistage pumps-pumps in series and parallel- performance of pumps-characteristic curves- NPSH-cavitation.

UNIT-V**(12 Lectures))****OPEN CHANNEL FLOW:**

Types of flows – Type of channels – Velocity distribution – Energy and momentum correction factors – Chezy's, Manning's and Bazin formulae for uniform flow – Most Economical sections. Specific energy-critical depth – computation of critical depth – critical, sub-critical and super critical flows.

Non uniform flow-Dynamic equation for G.V.F., mild, critical, steep, horizontal and adverse slopes-surface profiles-direct step method-Rapidly varied flow, hydraulic jump, energy dissipation.

TEXT BOOKS:

1. A.K.Jain, “*Fluid Mechanics Including Hydraulic Machines*”, 8th Edition, Khanna Publishers, New Delhi, 2003.

2. P.N Modi and S.M. Seth, “*Hydraulics and Fluid Mechanics Including Hydraulic Machines*”, 14th Edition, Standard Book House, 2002.
3. K. Subramanya, “*Flow in Open Channels*”, 2nd Edition, Tata Mc Graw hill Publishing Company Ltd, New Delhi, 2003.

REFERENCES:

1. Ven Te Chow, “*Open Channel Flow*”, 2nd Edition, Mc Graw Hill Book Company, New Delhi, 1998.
2. Srivatsava, “*Open Channel Flow*”, 2nd Edition, Oxford publishers, New Delhi, 1998.
3. R.K. Bansal, “*A textbook of Fluid mechanics and hydraulic machines*”, 9th Edition, Laxmi Publications (P) Ltd., New Delhi, 2010.
4. J.F. Douglas, J.M. Gasirock and J.A. Swaffield, “*Fluid Mechanics*”, 4th Edition, Pearson Education Publishers, 2001.

