

## 2/4 B.Tech. FOURTH SEMESTER

CE4T4

HYDRAULICS AND HYDRAULIC MACHINERY

Credits: 4

Lecture: 4 periods/week

Internal assessment: 30 marks

Tutorial: 1 period /week

Semester end examination: 70 marks

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### Objectives:

- To get knowledge about open channel hydraulic and the working of hydraulic machinery.

### Learning outcomes:

At the end of course the student will have:

- Knowledge regarding various theories dealing with the flow phenomenon of fluid in an open channel.
- Understanding of basics of the hydro-machinery and the components, function and use of different types of turbines and pumps.
- Ability to use dimensional analysis in solving fluid problems and plan hydraulic similitude studies.

### UNIT – I

#### OPEN CHANNEL FLOW - I:

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.

Critical flow: Specific energy-critical depth – computation of critical depth – critical sub-critical and super critical flows.

### UNIT II

#### OPEN CHANNEL FLOW - II:

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.

### UNIT - III

#### HYDRAULIC SIMILITUDE:

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

### UNIT – IV

#### 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 - V

#### HYDRAULIC TURBINES – I:

Layout of a typical Hydropower installation – Heads and efficiencies-classification of turbines- Pelton wheel - Francis turbine - Kaplan turbine-working, working proportions,

velocity diagram, work done and efficiency, hydraulic design, draft tube – theory and function efficiency.

#### **UNIT – VI**

##### **HYDRAULIC TURBINES – II:**

Governing of turbines-surge tanks-unit and specific turbines-unit speed-unit quantity-unit power-specific speed performance characteristics-geometric similarity-cavitation.

#### **UNIT – VII**

##### **CENTRIFUGAL-PUMPS:**

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

#### **UNIT – VIII**

##### **HYDROPOWER ENGINEERING:**

Classification of Hydropower plants – Definition of terms – load factor, utilization factor, capacity factor, estimation of hydropower potential.

### **Learning resources**

#### **Text books:**

1. Open Channel flow, (3<sup>rd</sup> edition) by Subramany, K., Tata McGraw-Hill, 2009.
2. A text of Fluid mechanics and hydraulic machines, (9<sup>th</sup> edition) by Bansal. R.K., Laxmi Publications (P) ltd., New Delhi, 2008.
3. Fluid Mechanics & Fluid Power Engineering, (8<sup>th</sup> edition) by Kumar, D.S., Kataria & Sons, 2013.

#### **Reference books:**

1. Fluid Mechanics, Hydraulics and Hydraulic Machines, (18<sup>th</sup> edition) by Modi and Seth, Standard Book House, 2011.
2. Elements of open channel flow by Ranga Raju, Tata McGraw-Hill, 2013.
3. Fluid mechanics and hydraulic machines, (9<sup>th</sup> edition) by Rajput, R.K., S. Chand & Co, 2009.
4. Open Channel flow by Chow, V.T., McGraw-Hill Book Company, 2008.
5. Hydraulic Machines, (6<sup>th</sup> edition) by Banga, T.R. and Sharma, S.C., Khanna Publishers, 2001.