

# 16CE208 HYDRAULICS AND HYDRAULIC MACHINES

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	-	30	6	40	5	15	3	-

## Course Description and Objectives:

The course deals with basic concepts of flow in open channel and working principles of different types of turbines and pumps. The objective of this course is to provide knowledge regarding uniform and non-uniform flows in open channels, impact of jet, study of different types of turbines and working of centrifugal and reciprocating pumps.

## Course Outcome:

The students will be able to:

- understand and analyse uniform, gradually and rapidly varied flows in an open channel.
- prepare and analyse models using concepts of similitude.
- understand working principles of turbines and pumps and their analysis and design.

## SKILLS:

- ✓ *Study different flow conditions in open channels*
- ✓ *Analyse critical and sub-critical flow in open channel.*
- ✓ *Analyse gradually and rapidly varied flow in open channel*
- ✓ *Study impact of jet on blades of turbines*
- ✓ *Determine performance characteristics of different types of pumps*

**UNIT – 1****L-09**

**DIMENSIONAL ANALYSIS AND SIMILITUDE:** Dynamical similarity and dimensional homogeneity model experiment, Geometric, Kinematic and Dynamic similarity, Reynold's, Froude, Weber, Euler and Mach numbers, Distorted and undistorted models, Principle of dimensional analysis Rayleigh method, Buckingham theorem, Applications of dimensional analysis to pipe Friction problems, Resistance to motion of partially and fully submerged bodies.

**UNIT – 2****L-09****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.

**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, Specific force curve.

**UNIT – 3****L-09****OPEN CHANNEL FLOW:**

**GRADUALLY VARIED FLOW:** Dynamic equation, Surface Profiles, Computation of surface profiles by single step and multi step methods, Examples of various types of water surface profiles, Control section.

**RAPIDLY VARIED FLOW:** Hydraulic jump, Elements and characteristics of hydraulic jump, Types of hydraulic jumps, Sequent depths, energy loss in a hydraulic jump.

**UNIT – 4****L-09**

**IMPACT OF FREE JETS:** Impact of a jet on a flat or a curved vane, Moving and stationary vane, Flow over radial vanes.

**TURBINES:** Classification, Efficiencies, Pelton wheel turbine, Francis turbine and Kaplan turbine, Governing of Pelton turbines, Draft-tube, Specific and unit quantities, Characteristic curves, Selection of turbines, Model tests.

**UNIT - 5****L-09**

**CENTRIFUGAL PUMP:** Components, Working principle, Manometric efficiency, Work done, Minimum starting speed, Pumps connected in series and parallel, Priming, Net positive suction head, Specific speed, Characteristic curves, Model testing.

**RECIPROCATING PUMPS:** Working principle, Single acting and double acting, Discharge slip, Work done, Indicator diagram, Air vessels.

**ACTIVITIES:**

- o *Prepare a model to demonstrate geometric similarity.*
- o *Design a channel section for uniform flow.*
- o *Prepare a model of Hydraulic Jump.*
- o *Design a model of Pelton turbine.*
- o *Design a model of centrifugal pump.*

---

## LABORATORY EXPERIMENTS

### LIST OF EXPERIMENTS

Total hours: 30

1. Impact of jets on Vanes.
2. Pelton wheel performance test.
3. Francis turbine performance test.
4. Multi stage centrifugal pump performance test.
5. Reciprocating pump performance test.

### TEXT BOOKS:

1. P. N. Modi and S. N. Seth, "Hydraulics and Fluid Mechanics", 20<sup>th</sup> edition, Standard Book house, New Delhi, 2013.
2. Dr. R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9<sup>th</sup> edition, Laxmi Publications, New Delhi, 2005.

### REFERENCE BOOKS:

1. K. Subramanya, "Open channel flow", 3<sup>rd</sup> edition, Tata McGraw Hill Publisher, 2008.
2. A. K. Jain, "Fluid Mechanics", 8<sup>th</sup> edition, Khanna Publishers, Delhi, 2002.