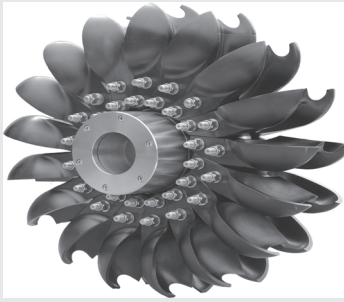
# 19CE212 HYDRUALIC ENGINEERING



*Source :www.2.bp.blogspot.com*

Hours Per Week :

| L | T | P | C |
|---|---|---|---|
| 3 | - | 2 | 4 |

Total Hours :

| L | T | P |
|---|---|---|
| 45 | - | 30 |

| WA/RA | SSH/HSH | CS | SA | S | BS |
|---|---|---|---|---|---|
| 25 | 48 | 6 | 12 | 3 | 5 |

**PRE-REQUISITE COURSES:** Fluid Mechanics

**COURSE DESCRIPTION AND OBJECTIVES:**

The main objective of this course is to make the student aware of basic ideas of Open channel hydraulics. It will help the students analyse and foresee various criteria that govern open channel flow. It will give them the wisdom required to choose a suitable turbine or pump as per their requirements. It will give the student a basic understanding of the physics behind the interactions between a fluid and the object moving inside it.

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to achieve the following outcomes:

| COs | Course Outcome | POs |
|---|---|---|
| 1 | Analyse the open channel sections for uniform and non uniform flows | 2 |
| 2 | Analyse the open channel sections for gradually and rapidly varied flows | 2 |
| 3 | Compute flow discharge using stream gauging and basic concepts concepts of hydro power engineering | 1,2 |
| 4 | Determine the drag and lift forces using boundary layer theory | 2 |
| 5 | Apply model laws for hydraulic machines using dimenstional analysis | 2 |

**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 I** **L-9**

**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 II** **L-9**

**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 III** **L-9**

**STREAM GAUGING:** Necessity, Selection of gauging sites, Methods of discharge measurement, Area-Velocity method, Measurement of velocity – Floats, Surface floats, Sub–surface float or Double float, Twin float, Velocity rod or Rod float, Pitot tube, Currentmeter; Measurement of area of flow, Measurement of width, Pivot point method, Measurement of depth – Sounding rod, Echo-sounder.

**WATER POWER ENGINEERING:** Introduction, Hydropower - Advantages & disadvantages, Estimation of hydro-power, Flow duration curve, Power duration curve, Load curve, Load factor, Capacity factor, Utilization factor, Diversity factor, Load duration curve, Firm Power, Secondary power, Types of hydel schemes, Forebay, Intake structures, Penstocks, Surge tank, Tail race.

**UNIT IV** **L-9**

**BOUNDARY LAYER THEORY:** Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients.

Boundary Layer Separation and Control. Drag and Lift forces, Formation of eddies, Bluff vs Streamlined Bodies, Wind Tunnel studies

**UNIT V** **L-9**

**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.Application of Dimensional Analysis to Pipe Friction Problems, Resistance to motion of partially or fully submerged bodies, Supersonic motion, and Applications of Froude's model law.

**INTRODUCTION TO HYDRAULIC MACHINES:** Impact of Jet on Vanes, Pumps and Turbines. **Pumps:** Classification, Working Principles, Efficiencies, Characteristic Curves, Priming, NPSH, Specific Speed, Minimum Starting Speed, Pumps in parallel and series, Air Vessels, Indicator Diagram. **TURBINES:** Classification,Working Principles, Efficiencies, Characteristic Curves, Draft Tube, Governing of Turbines, Unit Quantities, Selection of suitable type of turbine.

## LABORATORY EXPERIMENTS

**LIST OF EXPERIMENTS:** **TOTAL HOURS :30**

1. Calibration of Venturimeter.
2. Calibration of Orifice meter.
3. Friction factor for a given pipe line.
4. Head loss due to sudden contraction in a pipeline
5. Verification of Bernoulli's equation
6. Coefficient of discharge of Mouthpiece
7. Coefficient of discharge of Orifice
8. Discharge by V-Notch
9. Discharge by Rectangular – Notch
10. Impact of jets on Vanes.
11. Pelton wheel performance test.
12. Francis turbine performance test.
13. Multi stage centrifugal pump performance test.
14. Reciprocating pump performance test.

**TEXT BOOKS:**


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


**REFERENCES:**


1. V. L. Streeter and E.B. Wyile, "Fluid Mechanics", 9th edition, McGraw-hill Publications, 2011.
2. S. K. Som and G. Biswas, "Fluid Mechanics", 2nd edition, Tata Mc Graw Hill, 2008.
3. John F. Douglas, Janusz M. Gasiorek and John A. Swaffield, "Fluid Mechanics", 5th edition, Pearson Education Publishers, 2005