Hydraulics and Hydraulic Machines

15CV4DCHYM

INTRODUCTION

Hydraulic Engineering

Deals with flow and conveyance of fluids, particularly water

Hydraulic engineering aims at

- Understanding the physical processes of flow analytically or empirically
- Expressing these processes mathematically
- Use these understanding to design water related structures

Hydraulic Engineering…

Understanding

- Flow characteristics, Channel characteristics, Flow pattern, Forces acting

Mathematical expression

- Flow equations, Equations for flow profile, Expressions for energy

Design

- Channel cross section, Slope, Channel material, Cost involved, Efficiency, Energy loss, River training works, Control structures etc.

Hydraulic Engineering …

Applications:

- **Irrigation engineering:** Irrigation canals, Aqueducts, Super passages, Dams, Barrages
- **Water supply, drainage and sanitation** : Storm water drains, Sewage lines, Pipe network
- **Water quality :** Design of water treatment plant
- **River engineering:** Scouring, Pollution dispersion, River training works, Flood analysis, Flood control structures, Sedimentation studies
- Navigation canals, Hydro-electric power plants, Design of culverts and bridges

Course objectives

- To gain knowledge in **the fundamentals of hydraulics and hydraulic machines**
- Expose to **experimental techniques** in hydraulics and in the analysis of hydraulic machines

- Understand the difference between pipes and open channel flows
- Analyse uniform and non-uniform flow in open channels
- Design open channels

- Understand the impact of jet on various stationary and moving vanes
- Analyse the working of pumps and turbines
- Design pumps and turbines

Course outcomes

CO1: Understand and analyse the uniform and non-uniform flow in open channels

CO2: Understand impulse momentum equation and its application, carry out computations on impact of jet on fixed and moving plates

CO3: Understand the working of pumps and turbines and study the performance of these machines

Course content

FLOW IN OPEN CHANNELS

Introduction: Pipe Vs open channel flow, types of flows, geometric properties of open channels.

Uniform flow in open channels: Discharge equations, Economical sections, Condition for Maximum discharge & Minimum specific energy

Non-uniform flow in open channels: Gradually Varied flow, Hydraulic jump: types and applications.

HYDRAULIC MACHINES

Impact of jet on vanes: Impulse momentum equation, Force exerted by a jet of water on vanes

Turbines: Classification, theory, equation for work done and efficiency of various types of turbines

Pumps: Centrifugal pumps, work done, minimum starting speed

Laboratory Experiments

Demonstration Experiments

- Hydrostatic Bench
- Reynold's Apparatus
- Hele Shaw Apparatus
- Pressure drop in a Venturimeter

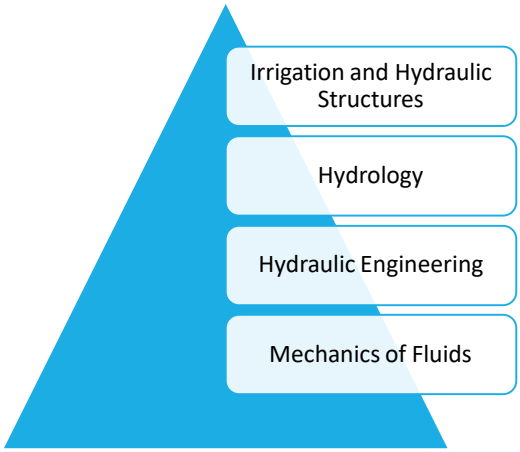
Hydraulic Machines

- Study the impact of jets on vanes
- Multi-stage centrifugal pump
- Study on turbines

Other experiments

- Friction in pipes
- Coefficient of discharge of an Orifice & Mouth Piece
- Coefficient of discharge of a V- Notch
- Coefficient of discharge of an oghee weir
- Coefficient of discharge of a Venturimeter

Hydraulics in your curriculum



Schedule

TERM-1
- Uniform flow in open channels
- Non-uniform flow

TERM-2
- Impact of jet on vanes
- Hydraulic turbines

TERM-3
- Centrifugal pumps

TEST-1
- Open channel flow (Uniform flow)
  Channel characteristics, Uniform flow, Economic channel section, critical flow

TEST-2
- Open channel flow (Non-uniform flow)
- Impact of jet on vanes
- Hydraulic turbines: Pelton wheel

TEST-3
- Impact of jet on vanes
- Hydraulic turbines
- Centrifugal pumps

Assessment Methods

Theory :

Maximum marks: 25

Tests: 2 x 10 = 20 Marks

Alternate assessment / Quiz = 5 Marks

Lab:

Maximum marks: 25

Record and conduction of experiments : 10

Lab exam : 15

SEE pattern

Question 2: Uniform flow/ critical flow/ economic channel section

Question 3: Non uniform flow (GVF and RVF)

Question 4: Impact of jet on vanes

Question 5: Turbines

Question 6: Pumps

Text book and reference books

1. Hydraulics and Fluid Mechanics : P.N Modi and S.M Seth

2. Fluid Mechanics and Hydrauic Machines: R.K Bansal

Reference books

3. A textbook of hydraulic machines : R.K Rajput

4. Fluid mechanics and hydraulic machines : Subramanya

5. Flow in open channels : Subramanya

6. Flow through open channels : Ranga Raju

7. Open channel hydraulics : Richard French

8. Fluid Mechanics : Cimbala

Online resource:
NPTEL lecture series

Wish you all the Best