COURSE TITLE : HYDRAULICS
COURSE CODE : 4011
COURSE CATEGORY : B
PERIODS/WEEK : 6
PERIODS/SEMESTER: 78
CREDITS : 5

TIME SCHEDULE

Module	Topics	Period
1	Liquid Pressure and its Measurements Flow of Liquids	19
2	Flow through orifices and mouth pieces, Flow over notches and weirs,	20
3	Flow through pipes, Flow through open channels	20
4	Pumps and Water Turbines Hydro Electric Installations	19
TOTAL		**78**

COURSE OUTCOME

Sl.	Sub	Student will be able to
1	1	Compute the total hydro static pressure & center of pressure
	2	Describe the principle of pressure measuring devices
	3	Identify the concept of fluid flow.
2	1	Compute the loss of water flowing through pipes.
	2	Design the most economical channel section.
	3	Understand different types of pumps and turbines
3	1	Understand the working of hydro electric power plant

SPECIFIC OUTCOME

MODULE-I LIQUID PRESSURE AND ITS MEASUREMENTS

1.1.0 Know the properties of liquids

1.1.1 Define density, specific weight, specific gravity ,Adhesion, Cohesion, Surface Tension, Capillarity, Compressibility, Dynamic Viscosity, Kinematic Viscosity and vapour Pressure

1.2.0 Understand liquid pressure and its measurements

1.2.1 Define intensity of pressure and pressure head at a point.
1.2.2 State Pascal's law.
1.2.3 Distinguish among atmospheric pressure, gauge pressure and absolute pressure
1.2.4 Calculate absolute pressure
1.2.5 Describe the pressure measuring instruments
1.2.6 Compute the pressure of a flowing liquid given the readings on a peizometer, U-tube and differential manometers
1.2.7 Compute the total pressure and centre of pressure on a horizontal, vertical or inclined surface immersed in liquid
1.2.8 Calculate the pressure on a sluice gate

1.3.0 Apply the general principles of flow of liquid

1.3.1 Distinguish different types of flow of liquids
1.3.2 State the equation of continuity of flow
1.3.3 Solve the problems using equation of continuity of flow
1.3.4 Identify the energy produced when a liquid is in motion
1.3.5 Define Bernoulli's theorem of total energy of liquid in motion
1.3.6 List the assumptions in Bernoulli's theorem
1.3.7 Derive Bernoulli's theorem of total energy of liquid in motion and State the limitations
1.3.8 Solve the problems on flow through pipes using Bernoulli's theorem
1.3.9 Describe the working of pilot tube, orifice meter and ventury meter
1.3.6 Compute the discharge of a flowing liquid using pitot tube, orifice meter and ventury meter

MODULE-II

2.1.0 Apply the principles of orifices & mouthpieces

2.1.1 Define orifice
2.1.2 Describe the types of orifice
2.1.3 Define vena contracta
2.1.3 Define coefficient of contraction, velocity and discharge
2.1.4 Deduce the relation between Cc, Cv and Cd
2.1.5 Describe the experimental determination of Cc, Cv and Cd
2.1.6 Solve the problems on hydraulic coefficients of small orifice
2.1.7 Define large rectangular orifice, submerged and partially sub merged orifice
2.1.8 Derive the formula for discharge through large rectangular orifice, submerged and partially sub merged orifice
2.1.9 Solve problems on discharge through a large rectangular orifice, submerged and partially submerged orifice
2.1.10 Derive the expression for finding the time for emptying a prismatic tank through an orifice at bottom or in the side
2.1.11 Compute the time of emptying a prismatic tank by an orifice
2.1.12 Differentiate between orifices and mouth pieces
2.1.13 Calculate the discharge through mouthpieces for the given details

2.2.0 Understand the working of common pumps

2.2.1 Describe the different parts of centrifugal pump and reciprocating pumps
2.2.2 State the use of foot valve and strainer in centrifugal pump
2.2.3 Describe the use of jet, air lift and deep well pumps

2.3.0 Understand the principles of working of water turbines

2.3.1 State the working of impulse and reaction turbines
2.3.2 Describe with sketches the principle of working of pelton wheel
2.3.3 Describe with sketches the working of Francis and Kaplan turbines
2.3.4 Describe the purpose of draft tube

MODULE-III

3.1.0 Comprehend the flow over different types of notches and weirs

3.1.1 Distinguish among rectangular, triangular and trapezoidal notches
3.1.2 Derive the formulae for the discharge over rectangular, triangular and trapezoidal notches
3.1.3 Calculate the discharge over the above notches from the given parameters
3.1.4 Differentiates sharp crested and broad crested weirs
3.1.5 Derive the formula for discharge over sharp crested and broad crested weirs
3.1.6 Describe the above formulae with modifications for end contractions and velocity of approach
3.1.7 Determine the discharge over sharp crested and broad crested weirs under given Conditions

3.2.0 Know the general layout and installation of hydro electric plants

3.2.1 Sketch a typical hydro electric installation
3.2.2 Describe the function of surge tank, penstock, anchor block and tail race

MODULE-IV

4.1.0 Understand the flow through pipes

4.1.1 Describe major and minor losses of head of water flowing through pipes
4.1.2 Derive Chezy's and Darcy's formulae for friction loss in pipe flow
4.1.3 Solve problems on pipe flow under friction
4.1.4 Sketch the hydraulic gradient and total energy line under different conditions
4.1.5 Compute the discharge through parallel pipe connected to a reservoir and flow through a siphon pipe under given conditions
4.1.6 Calculate the diameter of nozzle for maximum transmission of power
4.1.7 Differentiate Laminar and turbulent flows
4.1.8 Describe the effect of water hammer

4.2.0 Understand the principles of flow through open channels

4.2.1 Define the terms wetted perimeter and hydraulic mean depth
4.2.2 Differentiate uniform and non uniform flows
4.2.3 State Chezy's formula for uniform flow through open channels
4.2.4 Calculate the value of Chezy's constant using Kutter's and Manning's formula

4.2.5 Compute the velocity and discharge in a channel
4.2.6 Derive the conditions for most economical section of rectangular and trapezoidal channels
4.2.7 Solve the problems on flow through rectangular and trapezoidal channels for given conditions

CONTENT DETAILS

MODULE - I

Scope of hydraulics in engineering- definition of density, specific weight, specific gravity, viscosity-kinematics & dynamic viscosity, compressibility, vapour pressure, cohesion, adhesion, surface tension and capillarity. Intensity of pressure at a point -pressure head- units of pressure- Pascal's law (statement only) Atmospheric pressure, Gauge pressure ,Absolute pressure, vacuum pressure –problems. Measurements of atmospheric pressure- simple mercury barometers -pressure measuring devices- peizometer tubes, manometers -U-tube- simple, differential and inverted tubes only–Mechanical Gauge–Bourdon tube pressure gauge. Pressure on a plane surface immersed in liquid. Total pressure and center of pressure on horizontal, vertical and inclined surfaces immersed in liquids. Pressure on sluice gate–problems.

Flow of Fluid -Types of flow–uniform, non uniform, $dv/dt = 0$, $dv/dt \neq 0$, streamline ,turbulent, steady & unsteady flow, compressible & incompressible flow–Definitions and mathematical expression, $dv/dt = 0$, $dv/dt \neq 0$, $dv/ds = 0$, $dv/ds \neq 0$. Equation of continuity of flow–Problems. Types of energy need–static, pressure and velocity energy need–total energy of flowing liquid. Expressions for energy & height of liquid column .Bernoulli's theorem–statement and proof (Only 2–dimensional)–problems–Assumptions & limitations–application–venturimeter, orifice meter and pitot tube–Problems

MODULE–II

Flow through Orifices & Mouth pieces-Definition of orifice, types of orifices–(based on size, shape & flow conditions)–definition of vena contracta – hydraulic coefficients–Cv, Cc, Cd – experimental determination– problems. Submerged and partially submerged orifices. Large rectangular orifice-expression for discharge– derivation. Time for emptying a prismatic tank through an orifice at bottom or in the side-head loss due to sudden enlargement and sudden contraction at the entrance of pipe from large vessel, at the exit of a pipe line, obstruction in a pipe line derivation of expression for head loss due to enlargement & contraction- problems. Mouth piece–different types–external and internal-cylindrical–formula, discharge through them and problems. Pumps Centrifugal pumps, reciprocating pumps–working principle-description of propeller pumps, jet and air lift pumps, deep well pumps, Diaphragm pumps-description and application.

Turbines Classification

Impulse and reaction turbines, Pelton wheel, description and working (withoutproblem)
Description of reaction turbinesFrancis and Kaplan turbines (without problems)
Draft tube- purpose (description only)

MODULE- III

Notches -Definition, types of notches-rectangular, triangular and trapezoidal notch
Discharge over rectangular and trapezoidal notches. Derivations of expressions -problems. Advantages of triangular notches. Weirs- Classifications-definition-discharge over rectangular weir, end contraction in weir, effect of end-contraction over discharge, Francis formula and Bazin's formula for end contraction-problems-velocity of approach-problems, broad crested weir-problems, submerged weir description and problems.
Hydroelectric Installation Layout - intake works, pressure tunnel, penstock, surge tank, anchor blocks and-tailrace.

MODULE-IV

Flow through Pipes-Frictional loss in pipes -Chezy's and Darcy's formulae-Derivation and problems-Hydraulic gradient and total energy line. Water hammer and its effect (description only) .
Flow through Channels-Wetted perimeter, Hydraulic mean depth uniform and non-uniform flow-Chezy's formula and problems Kutter's, Mannings and Basin's formula-Most economical section of channel condition for-rectangular and trapezoidal-derivation –problems

REFERENCE BOOKS

1. Dr. R.K.Bansal : Fluid Mechanics & Hydraulic Machine ; Laxmi Publishers
2. R.S.Khurmi : Hydraulics, Fluid Mechanics & Hydraulic Machines; S. Chand & Co.
3. Modi & Sethi : Hydraulics & Hydraulic Machines ; Standard Publishers
4. R.K.Rajput : Hydraulics ; S.Chand & Co.
5. Jagdish lal : Hydraulics ; Dhanpat Rai & Sons