COURSE TITLE : HYDRAULICS
COURSE CODE : 3027
COURSE CATEGORY : B
PERIODS/WEEK : 5
PERIODS/SEMESTER : 90
CREDITS : 4

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Introduction, Liquid Pressure and its Measurements Flow of Liquids	23
II	Flow through orifices and mouth pieces, Pumps and Water Turbines	23
III	Flow over notches and weirs, Hydro Electric Installations	22
IV	Flow through pipes, Flow through open channels	22
	TOTAL	**90**

Rationale:

Hydraulics is a branch of engineering science deals with behavior of fluids at rest as well as in motion. Man encountered the problems in the field of water supply, Irrigation, Navigation are resulted in the development of Hydraulics.

Physical properties of water will play and important role in the through pipes, open channels. The empirical formulae developed in hydraulics have found useful application in several problems. The measurements of flow of water in pipes are useful in water supply system and assessment of water in irrigation field.

OBJECTIVES:

Upon completion of the course the student should be able to

1.1.0 Know the properties of liquids
- 1.1.1 Define, mass 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 Distinguish among atmospheric pressure, gauge pressure and absolute pressure
- 1.2.2 Describe the pressure measuring instruments
- 1.2.3 Compute the pressure of a flowing liquid given the readings on a peizometer, U-tube and differential manometers
- 1.2.4 Compute the total pressure and center of pressure on a horizontal, vertical or inclined surface immersed in liquid including sluice gates
- 1.2.5 Calculate reactions at hinges on look gates

1.3.0 To Understand the general principles of flow of liquid
- 1.3.1 Distinguish different types of flow of liquids
- 1.3.2 State the energies of liquid in motion

1.3.3 Explain Bernoulli's theorem of total energy of liquid in motion and its limitations
1.3.4 Solve problems on flow through pipes using Bernoulli's theorem
1.3.5 Explain the working of pilot tube orifice meter and venturi meter (problems)

2.1.0 Understand the function of orifices & mouthpieces

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

2.2.0 Understand working of common pumps

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

2.3.0 Understand the principles of working of water turbines

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

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 Explain 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 give 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 Explain the function of surge tank, penstock, anchor block and tail race

4.1.0 Understand the flow through pipes

4.1.1 Explain 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 a 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 diameter of nozzle for maximum transmission of power
4.1.7 Differentiate Laminar and turbulent flows
4.1.8 Explain the effect of water hammer
4.1.9 Explain Reynolds number and critical velocity in pipe

4.2.0 Understand the principles of flow through open channels

4.2.1 Define terms wetted perimeter and hydraulic mean depth

4.2.2 Differentiate uniform and non uniform flows
4.2.3 Derive Chezy's formula for uniform flow through open channels
4.2.4 Calculate the value of Chezy's constant given Kuter'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 problems on flow through rectangular and trapezoidal channels for given conditions

COURSE CONTENT

MODULE– I

Introduction

Scope of hydraulics in engineering – definition of density, specific volume, 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 plane surfaces immersed in liquid. Total pressure and center of pressure on horizontal, vertical and inclined surfaces immersed in liquids. Pressure on lock, gates, 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 metre/kg & height 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 size, shape flow condition) – 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 (without problem), Description of reaction turbines – Francis and Kaplan turbines (without problems)
Draft tube -purpose (description only).

MODULE– III

Notches

Definition, types of notches – rectangular, triangular and trapezoidal notches.

Discharge over rectangular, triangular and trapezoidal notches. Derivations of expressions and 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.

Hydro-electric Installation

Layout – intake works, pressure tunnel, pens lock, surge tank, action of 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) Syphon- problems.

Flow through Channels

Wetted perimeter Hydraulic mean depth- uniform and non-uniform flow – Chezy's formula – derivations / and problems

Kutter's, Mannings and Basin's formula – Most economical section of channel – condition for rectangular and trapezoidal -- derivation- problems

REFERENCE BOOKS

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