HYDRAULICS

Year: II **Semester: IV**

Teaching Hours/week				Examination Scheme						Total Marks
				Internal		Final				
				Theory	Practical	Theory		Practical		
Credit Hours	L	T	P			Duration	Marks	Duration	Marks	
3	3	3	2/2	40	25	3 Hrs	60	-	-	125

Course Objective:

The purpose of the course is to provide basic knowledge of Hydraulics i. e., the basics of Pipe Flows, Open Channel Flows and their applications in civil engineering.

Course Content:

9. Pipe Flow (11 hours)

9.1 Introduction to Hydraulics; Review of Continuity and Bernoulli's Equations; Laminar and Turbulent Flow; Reynolds' Number; HGL and TEL

9.2 Introduction to pipe flows

9.3 Head loss and types of head losses

9.4 Laminar flow in pipe; shear stress distribution; velocity distribution; head loss (Hagen-Poiseuille Equation)

9.5 Turbulent flow in pipe; shear stress; velocity distribution; Darcy-Weisbach's equation; Colebrook-White equation; Moody Diagram

9.6 Short and Long Pipes with constant diameters; Minor Head Loss and their types

9.7 Siphons: applications, condition for continuous supply, solutions to siphon problem

9.8 Types of simple pipe flow problems and solutions

Pipe Networks (5 hours)

9.9 Pipes in Series and Parallel

9.10 Equivalent Pipe; Dupuit equation
9.11 Three Reservoir Problem and its solution
9.12 Solution of simple network by Hardy-Cross method

10. Unsteady Flow in pipes (3 hours)

10.1 Water Hammer and its effects in pipes and Penstock
10.2 Water Hammer due to gradual closure of valve
10.3 Variation of pressure due to sudden closure of valve for the cases of rigid and elastic pipes
10.4 Relief devices against action of water hammer; surge tank and its types.

11. Basics of Open Channel Flow (2 hours)

11.1 Practical Applications of Open Channel Flow
11.2 Difference between pipe flow and open channel flow
11.3 Classification of open channels
11.4 Classification of open channel flow
11.5 Geometric properties of channel

12. Uniform Flow in Open Channels (6 hours)

12.1 Condition of uniform flow in prismatic channel
12.2 Shear stress and velocity distribution
12.3 Chezy's and Manning's equations; Relationship between Chezy's, Manning and Darcy's coefficient
12.4 Most economic rectangular, triangular, trapezoidal and circular section
12.5 Types of uniform flow problems and solutions

13. Flow over Notches and Weirs (3 hours)

13.1 Weirs and Notches; Types of weirs/notches
13.2 Discharge equations for Rectangular, Triangular and Trapezoidal weirs, Francis' formula, Cipoletti weir
13.3 Velocity of Approach

14. Energy and Momentum Principles in open channels (4 hours)

14.1 Energy and Momentum Principles
14.2 Specific energy, specific energy curve, critical depth, alternate depths of flow and depth-discharge relationship
14.3 Use of specific energy concept in analyzing flow over broad-crested weir and Venturi flume.
14.4 Concept of specific force

15. Non-Uniform Flow in Open Channels: Gradually Varied Flow and Rapidly Varied Flow (8 hours)

15.1 Governing equation of gradually varied flow and assumptions in their derivations
15.2 Classification of bed slopes
15.3 Classification of water surface profiles
15.4 Computation of GVF in prismatic channels by Step Method
15.5 Rapidly Varied Flow: Hydraulic Jump conditions and equation in horizontal rectangular channel.
15.6 Energy Loss in Hydraulic Jump
15.7 Practical Examples of Jump

16. Flow in Non-rigid Boundary Channel (1 hour)

16.1 Introduction; Difference between Rigid and Non-rigid boundary channel
16.2 Effects of shear stress and incipient motion, Critical tractive stress

17. Similitude and Physical Modeling (2 hours)

17.1 Definition and Types of Similarities
17.2 Classification of Models: Distorted and Undistorted Models; Scale Effect
17.3 Modeling Criteria

Laboratory Works:

8. Head Loss in Pipes
9. Flow through sluice gates
10. Flow over notches and weirs
11. Flow along Metering Flumes
12. Analysis of Gradually Varied Flow (optional)
13. Analysis of Rapidly Varied Flow (optional)

References*:

12. Bansal, R. K. (2019). *A Textbook of Fluid Mechanics and Hydraulic Machines*. 10th edition, Laxmi Publications
13. Cengel, Y. A. & Cimbala, J. M. (2013). *Fluid Mechanics: Fundamentals and Applications.* 3rd edition, Mcgraw-Hill
14. Chow, V. T. (2009). *Open-Channel Hydraulics*. The Balckburn Press
15. Dulal, K.N. (2022). *Hydraulics*. 1st Edition, Pratibha Pustak Sadan.

16. Kumar, D. S. (2013). *Fluid Mechanics and Fluid Power Engineering*. 8th edition, S. K. Kataria and Sons
17. Modi, P. N. & Seth, S. M. (2015). *Hydraulics and Fluid Mechanics including Hydraulic Machines*. 20th edition, Standard Book House
18. Sangroula, D. P. (2018). *Fundamentals of Fluid Mechanics*. 3rd edition, Green Books
19. Streeter, V. L., Wylie, E. B. & Bedford, K. W. (2010). *Fluid Mechanics*. 9th edition, Mcgraw-Hill
20. Subramanya, K. (2019). *Flow in Open Channels*. 5th edition, Mcgraw-Hill India

**Latest edition will be preferable.*

Evaluation Scheme: Marks Division

Question Type	No. of Questions	Marks	Total Marks
Short	4	2	8
Medium	7	4	28
Long	3	8	24
Total			60