GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3140611
Semester – IV
Subject Name: Fluid Mechanics & Hydraulics

Type of course: Professional Core Course

Prerequisite: System of units, Laws of motion, Basic idea of force, Concept of centroid & Moment of Inertia

Rationale:
1. To develop a basic understanding about the properties of fluids, their behavior under static and dynamic conditions.
2. To enable the students to apply the basic principles of Fluid Mechanics to solve real life problems

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Module 1:Properties of Fluids Mass density, specific weight, specific gravity, specific volume, vapour pressure, compressibility, elasticity, surface tension, capillarity; Newton's law of viscosity, Types of fluids, dynamic viscosity, kinematic viscosity, variation of viscosity with temperature; Basic applications of fluid mechanics	4
2	Module 2: Fluid Statics Measurement of Pressure: Pressure variation in static fluid, Pascal's law, Units and scale of pressure measurement- Atmospheric pressure, Absolute pressure, Gauge pressure, and Vacuum pressure, Hydrostatic paradox, Piezometer, U-Tube manometer, Single column manometer, U-tube differential manometer, Inverted U-tube differential manometer, micromanometers. Hydrostatic force on plane and curved surface: Total pressure and center of pressure, pressure diagram, Total pressure on plane surfaces and curved surfaces depth of center of pressure, Practical applications of Total pressure and Center of pressure. Buoyancy and Flotation: Buoyant force, Buoyancy and Center of Buoyancy, Archimedes Principle, Metacentre and Metacentric height, Equilibrium of floating and submerged	12

	bodies, Metacentric height evaluation –theoretical and experimental method.	
3	Module 3:Fluid Kinematics & Dynamics Fluid flow methods of analysis of fluid motion, Streamlines, Path lines, Streak lines and Stream tubes. Types of fluid flow-Steady and unsteady flow, Uniform and non-uniform flow, Laminar and turbulent flow, Reynolds number, Reynolds experiment, Rotational and Irrotational flow, Subcritical, critical and Supercritical flow, Compressible and Incompressible flow, One, Two and three dimensional flow velocity potential and stream function, flow net, Euler's equation, Bernoulli's equation and its applications.	**8**
4	Module 4: Flow Measuring Devices Measurement of discharge- Venturimeter, Orificemeter, Nozzlemeter, Rotometer. Measurement of velocity-Pitot tube. Orifice- classification hydraulic coefficients, Experimental determination of hydraulic coefficients, Small and large orifice,. Mouthpiece- classification, External cylindrical mouthpiece, Convergent –divergent mouthpiece, Borda's mouthpiece. Notches and weirs-discharge over rectangular notch and triangular notch. Velocity of approach	**8**
5	Module 5: Flow Through Pipes Introduction-Continuity equation-Energy equation-Momentum equation Major and minor energy losses, hydraulic gradient and total energy line, pipes in series and parallel, pipe networks by Hardy Cross method Viscous flow-Couette flow, Hagen-Poiseuille equation-flow between parallel plates. Turbulent flow in pipes-Prandtl's mixing length theory Smooth and rough boundaries-water hammer phenomenon	**12**
6	Module 6: Open Channel Flow Basic concept of open channel flow- Steady uniform flow-Velocity distribution-Optimum shape of cross section for uniform flow- Energy equation-specific energy-specific energy diagram-discharge diagram-Application of specific energy and discharge diagrams. Non-Uniform steady flow-equations for gradually varied flow- Direct Step method, Rapidly varied flow- Hydraulic jump.	**10**
7	Module 7: Dimensional Analysis and Similitude Fundamental dimensions-Physical Quantity and Dimensions-Dimensional Homogeneity-Non Dimensional parameters, Theorem dimensional analysis, Choice of variables,	**6**

	Determination of Dimensionless parameters. Model Similitude-Physical models-geometric-kinematic and dynamic similarity,	

Suggested Specification table with Marks (Theory): (For PDDC only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	**20%**	**20%**	**20%**	**10%**	**10%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Engineering Fluid mechanics, K.L. Kumar, 8th Edition S. Chand & Company Ltd.
2. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
4. Fluid Mechanics, A.K. Jain, 4th edition, Khanna Publishers.
5. Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication
6. Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi
7. Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi
8. Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication
9. Fluid Mechanics by Frank M White , McGraw Hill Publication

Course Outcomes: At the end of the course, Student will be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Analyze forces on floating bodies and understand fluids in relative equilibrium	20
CO-2	Calibrate and demonstrate fluid flow measuring devices like venturimeter, orificemeter, notches, orifice, mouthpieces.	25
CO-3	Analyze fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions	20
CO-4	Analyze open channel flow and design optimal sections; calculate forces on sluice gates considering specific energy and momentum principle.	25

CO-5	Carry out model studies for fluid flow problems	10

List of Experiments:

1. Measurement of viscosity
2. Study of pressure measurement devices
3. Hydrostatic force and center of pressure on flat/curved surfaces
4. Stability of Floating body
5. Study Characteristics of Laminar and Turbulent flows (Reynolds experiment)
6. Verification of Bernoulli Theorem
7. Determine Hydraulic coefficients of a small circular orifice.
8. Calibration of flow measuring devices (Venturimeter, Orificemeter, Rectangular and V-notch)
9. Pipe friction
10. Uniform flow in Open Channel
11. Similitude and Model Studies

Major Equipment:

1. Viscometer
2. Piezometers, Manometers, pressure gauges
3. Floating body
4. Reynolds experimental setup
5. Hydraulic bench with modular attachments for various experiments
6. Pipe friction apparatus
7. Open channel with necessary attachments for Uniform flow and Hydraulic Jump experiment

List of Open Source Software/learning website:

1. http://www.nptel.iitm.ac.in/courses/