GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL AND INFRASTRUCTURE ENGINEERING
FLUID MECHANICS AND HYDRAULICS
SUBJECT CODE: 2154002
B.E. 5th SEMESTER

Type of Course: Core

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

Rationale: Fluid Mechanics and Hydraulics is conceptual applications of fluid mechanics and hydraulics. With the help of this knowledge students may be able:

1. To understand the fundamentals of the fluid mechanics such as fluid and flow properties, fluid behavior at rest and in motion and fundamental equations like mass, energy and momentum conservation of the fluid flow.
2. To understand the devises and methods for flow measurements
3. To apply the basic principles of Fluid Mechanics & hydraulics to solve real life problems involving hydraulic pumps, pipe network flow, turbines etc.
4. To understand the characteristics of open channel hydraulics

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Contents:

Sr. No	Topics	Hrs.	% Weightage
1	**Properties of Fluids:** Introduction, Fluid properties and classification; concept of viscosity, compressibility and Elasticity, Surface tension and capillarity. Newton's law of viscosity, dynamic viscosity, classification of fluids, kinematic viscosity, variation of viscosity with temperature, Surface tension and capillarity.	4	10%
2	**Fluid Statics** Pascal law, Hydrostatic law, Relative equilibrium, Pressure measurements-atmospheric pressure, Absolute pressure, Gauge pressure, and Vacuum pressure, Piezometer, Mano-Meters, Forces on immersed bodies: Drag and Lift.	6	10%
3	**Fluid Kinematics:**	6	10%

	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, Circulation and vorticity, Stream function and Flownet.		
4	**Fluid Dynamics:** Equation of Motion: Euler's equation, Bernoulli's equation, Energy correction factor, Coefficients of contraction, velocity and discharge, Differential head meters, Free vortex motion, Analysis of free liquid Jet, Cavitation. Linear momentum equation, Force on pipe junctions and bends, Forces on moving plates and vanes due to fluid flow, Angular momentum, Forced vortex.	6	10%
5	**Flow Measuring Devices:** Measurement of discharge-Venturimeter, Orifice meter, mouth pieces, Nozzle meter, Rotometer, Weirs, Flow under sluice gates. Time of empting tanks with or without inflow. Measurement of velocity-Pitot tube.	4	10%
6	**Hydraulic Machines:** Turbines: classification of tribunes, Impulse and Reaction turbines, characteristic curves, draft tubes, Pumps: classification of pumps, centrifugal pump, efficiency and power, Output of centrifugal pumps, characteristics curves.	6	10%
7	**Pipe Hydraulics:** Review of the basic equations: continuity, momentum, and energy. Flow through closed conduits: Laminar flow, Turbulent flow. Pipe Flow Problems: Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe networks, unsteady flow in pipes, water hammer analysis.	7	15%
8	**Open Channel Hydraulics:** Flow through open channels: Uniform flow, Critical flow, Gradually Varied flow, Rapidly Varied flow, Spatially Varied flow, Unsteady flow. Dimensional analysis, Buckinghum's theorem.	7	15%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**30**	**15**	**15**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above

Reference Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House

2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Srivastava, R. (2008). Flow through Open Channels, Oxford University Press.
4. Engineering Fluid mechanics, K.L. Kumar, 8th Edition S. Chand & Company Ltd.
5. Fluid Mechanics, A.K. Jain, 4th edition, Khanna Publishers.
6. Fox, R.W., and McDonald, A.T. (1996). Introduction to Fluid Mechanics, John Wiley.
7. Asawa, G.L. (2005). Irrigation and Water Resources Engineering, New Age International Ltd.
8. Streeter, V.L. ,Wylie, E. Benjamin , Fluid Mechanics , McGrawHill, London, 1998.

Course Outcome:
After successful completion of the course the students shall be able to:
1. Describe types of fluid and determine their properties.
2. Measure pressure and calculate hydrostatic pressures and forces on flat/curved surfaces.
3. Analyze forces on floating and immersed bodies and understand fluids in relative equilibrium.
4. Know the basics of fluid kinematics and dynamics and understand and apply the Bernoulli principle.
5. Calibrate fluid flow measuring devices like Venturimeter, orifice meter, notches, orifice, and mouthpieces.
6. Understand the concept of various pipe networks, pumps, turbines etc. for life applications
7. Know the characteristics of open channel hydraulics

List of Experiments:

Laboratory Sessions:	Name of Experiment
1	Momentum equation: Impact of a jet
2	Energy Equation: Verification of Bernoulli's theorem
3	Friction losses in pipes
4	Minor losses in pipe fittings
5	Pipes in series and parallel
6	Hydraulic jump in open channels
7	Flow measurement: In pipes, using Venturimeter and orifice meter
8	Flow measurement: In open channels, using weirs
9	Forces on immersed bodies: Fall velocity
10	Unsteady flow in pipes: Water Hammer
Total number of laboratory sessions: 10	

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.