GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3140110
Semester –IV
Subject Name: Fluid Mechanics

Type of course: Basic Science

Prerequisite: Nil

Rationale: This course imparts fundamental knowledge regarding fluid and its properties, various types of flow, governing equations in static and moving conditions.

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	Weigh tage
1	**Fluids and Their Properties:** Fluid classifications, hypothesis of continuum, shear stress in a moving fluid, molecular structure of material, density, viscosity, surface tension, capillary effect, vapor pressure, compressibility and the bulk modulus, pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, hydrostatic paradox	**08**	**15%**
2	**Fluid Statics and Buoyancy:** Fluid static, action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure and surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body and floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy	**08**	**20%**
3	**Kinematics of flow and Potential Flow :** Introduction, Classification of fluid flows: Laminar and Turbulent flow, Steady and Unsteady flow, Uniform and Non-uniform flow, Compressible and Incompressible flow, Ideal and Real flow, Rotational and Irrotational flow, One, two and three-dimensional flow, Frames of reference , analyzing fluid flow, motion of a fluid particle, acceleration of a fluid particle, discharge and mean velocity , continuity of flow, continuity equations for 2-D and 3-D flow in Cartesian coordinates of system, Streamlines, Path lines and Streak lines, Circulation and Vorticity, Stream function and Potential function, relation between Stream function and Potential function, theory of notches and weirs Introduction, Important cases of potential flow, Uniform flow, Source flow, Sink flow,	**10**	**20%**

	Free vortex flow, Source and Sink pair, Doublet, Flow past a half body, Flow past a Rankine oval body, Flow past a circular cylinder		
4	**Fluid Dynamics:** Introduction, Equation of motion, Euler's equation, Bernoulli's theorem : integration of Euler's equation for one dimensional flow, Bernoulli's equation for real fluid, kinetic energy correction factor Applications of Bernoulli's equation: Venturimeter, Orifice Meter, Pitot tube, Momentum equation, Navier-Stokes equations and its applications Introduction to CFD, Steps involved in CFD, Applications of CFD, Experimental vs. Numerical approach	**10**	**15%**
5	**Dimensional Analysis and Model Similitude:** Introduction, Secondary or derived quantities, Dimensional homogeneity and its applications, Dimensional analysis : Rayleigh's method & Buckingham's π-theorem, Types of similarities, Model laws, Undistorted models & Distorted models Dimensionless numbers and their significance: Reynolds number Re, Froude number Fr, Mach number M, Weber number W, Euler number E.	**06**	**10%**
6	**Viscous Flow and Turbulent Flow :** Introduction, Reynolds's Experiment, Laminar flow in circular pipes-Hagen-Poiseuille formula, Flow of viscous fluid between two parallel plates, Coutte flow, Kinetic energy correction factor α and momentum correction factor β, Power absorbed in viscous flow through Journal Bearing, Foot-step Bearing and Collar Bearing, Determination of Viscosity Introduction to Turbulent flow, Characteristics of Turbulent flow, Darchy Weishbach equation, moody diagram, resistance of smooth and rough pipes, shear stress and velocity distribution in turbulent flow through pipes	**08**	**20%**
7	**Flow through pipes:** Major and minor energy losses ,hydraulic gradient and total energy lines, pipes in series and parallel, equivalent pipes, water hammer in pipes	**04**	
8	**Boundary Layer Flow:** Introduction, Laminar boundary layer, Turbulent boundary layer, Laminar sub-layer, Boundary layer thickness, Displacement thickness, Momentum Thickness, Energy thickness, Lift and Drag, Drag force on a flat plate due to boundary layer, Turbulent boundary layer on a flat plate, Drag on Sphere, Terminal Velocity, Lift and Drag on Cylinder, Development of Lift on an airfoil	**06**	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**25**	**20**	**20**	**10**	**0**

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. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.Kataria & Sons.
2. Fluid Mechanics and Hydraulic Machines by Dr. R K Bansal, Laxmi Publication
3. Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd.
4. Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S.Chand & Co.
5. Mechanics of Fluids by Shames, McGraw Hill Publishing Company Ltd.
6. Introduction to Fluid Mechanics and Fluid machines by S K Som & G Biswas, McGraw Hill Publishing Company Ltd
7. Fluid Mechanics by Victor L Streeter & E. Benjamin Wylie, McGraw Hilll 1983.

Course Outcomes:

Upon completion of this course students should be able to:

Sr. No.	CO statement	Marks % weightage
CO1	Explain various fluid and fluid properties.	15%
CO2	Analyze fluid statics, fluid kinematics & dynamics.	55%
CO3	Illustrate Viscous flow and Turbulent flow.	20%
CO4	Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.	10%

List of Experiments:

1. To verify Bernoulli's Equation
2. To study Pressure and its measurement
3. To determine Metacentric height using Metacentric apparatus.
4. To determine Discharge co-efficient of V-Notch.
5. To find discharge coefficient of Venturimeter.
6. To study different types of flow.
7. To determine viscosity of fluid by Falling sphere method.
8. To find friction factor for pipes of different material of same diameter.
9. To study Dimensional analysis.
10. To verify Froude's model law
11. Introduction to CFD software.

List of Open Source Software/learning website:

https://nptel.ac.in/