



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3134005

Semester – III

Subject Name: Fluid Mechanics and Hydraulics

Type of course: Engineering Science

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

Rationale:

Fluid Mechanics and Hydraulics is conceptual applications in the field of engineering science. With the help of this knowledge students may be able:

1. To understand the fundamentals of fluid mechanics, which is used in the applications of Hydraulics, Infrastructure Engineering, Marine Engineering, etc.
2. To understand the fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. To imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. To understand the importance of fluid flow measurement and its applications in industries.
6. To determine the losses in a flow system, flow through pipes, and flow past immersed bodies.
7. To understand the characteristics of open channel hydraulics and hydraulic machines.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Introduction to fluids and their applications, Concept of continuum, Knudsen number, Properties of fluids: Density, Specific weight, Temperature, Viscosity, Compressibility, Surface Tension, Elasticity, Thermal conductivity, Specific Heat, and Vapour pressure.	4
2	Fluid Statics: Pascal law, Hydrostatic law, Pressure and its types, Measurement of pressure using Barometer, Bourdan tube pressure gauge, Pressure transducer, Piezometer Column, U-tube and differential manometers, Hydrostatic forces on surfaces, Buoyancy and floatation.	6
3	Fluid Kinematics: Velocity field, Fluid flow methods for analysis of fluid motion, Types of fluid flows- Ideal and real flow, Steady and unsteady flow, Uniform and non-	6



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3134005

	uniform flow, Compressible and incompressible flow, Laminar and turbulent flow, Rotational and irrotational flow, One, two and three dimensional flow Streamlines, Path lines, Streak lines and Stream tubes, Continuity equation, Circulation and vorticity, Fluid rotation and deformation, Stream function and velocity potential function, Flow net and its characteristics. Vortex flow: free vortex and forced vortex flow.	
4	Fluid Dynamics: Concept of control mass and control volume, Reynolds transport theorem, Conservation of mass and momentum equations, Euler's equation, Bernoulli's equation and applications of momentum and energy equations, Energy correction factor, Linear momentum equation, Analysis of free liquid jet, Reynolds experiment, Critical Reynolds number and its determination, Laminar flow through pipes and Hagen-Poiseuille equation, Coquettes flow, Characteristics and factors affecting turbulence, Velocity distribution for laminar and turbulent flow through pipe, Darcy-Weisbach equation for turbulent flow through pipe.	6
5	Fluid Flow Measurements: Flow measurement devices; Venturimeter, Orifice meter, Pitot tube, Mouth pieces, Nozzle meter, Rotometer, Weirs, Flow under sluice gates.	6
6	Pipe Hydraulics: Major and minor losses in pipes, Total energy line and hydraulic gradient lines, Siphons, Pipes connected in series and parallel, Branched pipes, Pipe networks, Water hammer analysis, Pipe network, Dimensional analysis, Rayleigh's method and Buckingham's π -theorem, Dimensionless numbers- Reynold's number, Froude's number, Euler's number, Weber's number and Mach's number.	7
7	Open Channel Hydraulics: Flow through open channel: Steady-unsteady flow, Uniform and non-uniform flow, Critical flow, Gradually varied flow, Rapidly varied flow, Spatially varied flow, Hydraulic jump.	5
8	Hydraulic Machines: Turbines: classification of tribunes, Impulse and Reaction turbines, draft tubes, efficiency. Pumps: classification of pumps, centrifugal pump, efficiency and power.	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	15	15	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. Introduction to Fluid Mechanics and Fluid Machines, S.K.Som, Gautam Biswas and Suman Chakraborty, Mc Graw Hill Education.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3134005

2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
3. Flow through Open Channels, R. Srivastava, Oxford University Press.
4. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House.
5. Fluid Mechanics and Hydraulic Machines, Dr. R.K.Bansal, Laxmi Publication.
6. Fluid Mechanics, Douglas, J. Gasiorek, J. Swaffield, L. Jack, Longman Publication.
7. Fluid Mechanics, A.K. Jain, Khanna Publishers.
8. Introduction to Fluid Mechanics, R.W. Fox, and A.T. McDonald, John Wiley.

Course Outcomes:

Sr. No.	CO Statement	Marks % weightage
CO-1	Types of fluid and determine their properties.	10
CO-2	Basics of fluid statics and kinematics	30
CO-3	Basics of fluid dynamics and fluid flow measuring devices: Venturimeter, Orificemeter, Notches, Rotameter and Mouthpieces.	30
CO-4	Concept of various pipe flows, pipe losses, pipe networks, etc. for real life applications.	15
CO-5	Characteristics of open channel hydraulics and hydraulic machines.	15

List of Assignments:

Sr. No.	Assignment Statement
1	Fluids properties: Density, Viscosity, Capillarity and Surface tension.
2	Type of fluid flows based on Reynolds theorem.
3	Bernoullis equation for an incompressible fluid flow.
4	Coefficient of discharge for Venturimeter and Orificemeter.
5	Force exerted on stationary plate by impact of jet.
6	Major and minor losses in pipe flow.
7	Coefficient of discharge for rectangular, triangular and trapezoidal notch.
8	Concept of fluid velocity using Pitot tube.
9	Surface profile of free and forced vortex flow.
10	Hydraulic jump phenomenon in open channel.
11	Force balancing in fluid statics.
12	Pumps and Turbines.

List of Open Source Software/Learning website: www.nptel.iitm.ac.in/courses/