GUJARAT TECHNOLOGICAL UNIVERSITY

AERONAUTICAL ENGINEERING (01) / MINING (22)

FUNDAMENTALS OF FLUID MECHANICS

SUBJECT CODE: 2130101

B.E. 3RD SEMESTER

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Understanding fundamental principles of fluid is required in various field of engineering.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Fluids and Their Properties: Fluids, Shear stress in a moving fluid, Difference between solid and fluid, Newtonian and Non-Newtonian Fluid, Liquids and Gases, Molecular structure of material, the continuum concept of a fluid, density, viscosity, causes of viscosity in gases, causes of viscosity in a liquid, Surface tension, capillary, vapor pressure, cavitation, compressibility and the bulk modulus, Equation of states of a gas constant, Specific heats of a gas, Expansion of a gas.	05	35%
2	Pressures and Head: Static's of a fluid system, 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, the hydrostatic paradox, pressure measurements by manometers, forced vortex	06	
3	Static Forces on Surface and Buoyancy: Action of fluid pressure on surface, resultant force and center of pressure on a plane surface under uniform pressure, resultant force and center of pressure on a plane 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, stability of floating bodies, determination of the metacentric height, determination of the position of the metacenter relative to the center of buoyancy, periodic time of oscillation.	06	
4	Motion of Fluid Particles and Streams: Fluid flow, different types of flow, Speed of sound, mach number, Types of flow based on mach number, Area-Velocity Relation, Characteristics of diff. types of flow (Laminar & Turbulent Flows), expression for coefficient of friction, DarchyWeichback equation, Applications of Turbulent Flow, frames of reference, real and ideal	06	35%

	fluids, 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.		
5	The Energy Equation and its Application: Momentum and fluid flow, Momentum equation for 2-D and 3-D flow along a stream line, momentum correction factor, Euler's equation of motion along a stream line, Mechanical energy of a flowing fluid – Bernoulli's theorem, kinetic energy correction factor, pitot tube, determination of volumetric flow rate via pitot tube, changes of pressure in tapering pipe, principle of venture meter, pipe orifices, Limitation on the velocity of flow in a pipeline, theory of small orifices discharging to atmosphere, theory of large orifices, Elementary theory of notches and weirs, flow in a curved path, pressure gradient and change of total energy across the streamlines.	07	
6	Dimensional Analysis And Similarities: Dimensional analysis, dimensions and units, dimension reasoning, dimensional quantities, Fundamental and derived units and dimensions, dimensions of derivative and integrals, use of dimensional reasoning to check calculations, units of derived quantities, conversion from one system of unit to another, conversion of dimensional constants, dimensional homogeneity, dimensional analysis using the indicial method- Rayleigh's method, dimensional analysis using group method- Buckingham πtheorem, significance of dimensionless group, use of dimensionless groups in Experimental investigation, geometric similarity, dynamic similarity, Kinematic similarity, Model testing- Model laws, Undistorted and Distorted models.	06	20%
7	Viscous Flow: Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe-HAGEN-POISEVILLE LAW, Flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, Foot step and Collar bearing , Movement of piston in dash pot, Methods of Measurement of viscosity.	03	10%

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K.Kataria& SSons
2. Fluid Mechanics and Hydraulic Machines by R.K. Rajput ,S.Chand& Co.
3. Theory and Applications of Fluid Mechanics by K.Subramanya, TMH outline series, Tata McGraw Hill Publishing Company Ltd.
4. Fluid Mechanics by Frank .M. White, McGraw Hill Publishing Company Ltd.
5. Mechanics of Fluids by Shames, McGraw Hill Publishing Company Ltd.

Course Outcome:

After learning the course the students should be able to

1. To know about the basic fundamentals of fluid mechanics and respective properties of the fluid
2. To understand pressure head
3. To understand the behavior of the fluid under static condition
4. To know about the basic fundamentals for governing equations of fluid mechanics and engineering
5. To understand the importance and application of dimensional analysis
6. To understand and differentiate the ideal fluid flow and real fluid flow
7. To understand the basic of turbulent and compressible flow

List of Practicals:

1. Verification of Bernoulli's Equation
2. Study of Pressure and its measurement
3. Determination of Metacentric Height
4. Determination of Discharge co-efficient of V-Notch
5. Calibration of Venturimeter
6. Study of various types of Fluid Flow
7. Determination of viscosity of fluid
8. Pipe friction apparatus
9. Study of Dimensional analysis
10. Verification of Froude's model law
11. To calibrate wind tunnel by using pitot tube.

Open Ended Problems:

Apart from above experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below.

1. Develop Venturimeter.
2. Develop Froude's law setup.
3. Develop Boat Stability model

Major equipment: Bernoulli's experiment setup, Venturimeter, Pipe friction apparatus, Reynolds's experiment setup, V-notch, Froude's model law setup, Pitot tube setup with U-tube Manometer.

ACTIVE LEARNING ASSIGNMENTS: 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.