CBCS SCHEME

USN | | | | | | | | | | |

BME403

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following properties of fluids and write their SI units. i) Density ii) Specific weight iii) Specific volume iv) Kinematic viscosity.	8	L1	CO1
	b.	If the velocity distribution over a plate is given by $u = \frac{2}{3}y - y^2$ in which 'u' is the velocity in meter per second at a distance 'y' meter above the plate, Determine the shear stress at y = 0 and y = 0.15m. Take dynamic viscosity of fluid as 8.63 poises.	6	L3	CO1
	c.	Define capillarity. Derive an expression for capillary rise.	6	L2	CO1
		OR			
Q.2	a.	State and prove Pascal's law.	6	L2	CO2
	b.	Define the following and indicate their relative position on a chart: i) Absolute pressure ii) Gauge pressure iii) Vacuum pressure iv) Atmospheric pressure.	6	L1	CO2
	c.	The right limb of a simple u-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.	8	L3	CO2
		Module – 2			
Q.3	a.	Define the following types of fluid flows: i) Steady and unsteady flow ii) Uniform and non-uniform flow iii) Compressible and incompressible flow.	6	L1	CO2
	b.	Derive the continuity equation in three dimensional Cartesian co-ordinates for a steady, incompressible fluid flow.	8	L2	CO2
	c.	Explain stream function and velocity potential function.	6	L2	CO2

		OR			
Q.4	**a.**	Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe.	**10**	**L2**	**CO2**
	b.	A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow.	**6**	**L3**	**CO2**
	c.	Define Reynolds number. Explain its significance in fluid flow.	**4**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Derive Euler's equation of motion along a stream line. Deduce Bernoulli's equation from Euler's equation. State the assumptions made.	**10**	**L2**	**CO3**
	b.	A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position 'A' to 500 mm diameter at a position 'B' which is 4 m at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 lit/s, determine the loss of head and direction of flow.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive Darcy – Weisbach equation for loss of head due to friction in pipe.	**10**	**L2**	**CO3**
	b.	A horizontal pipe line 40 m long is connected to a water tank at one end and discharge freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the following terms: i) Drag ii) Lift iii) Friction drag iv) Pressure drag.	**8**	**L2**	**CO4**
	b.	Briefly explain what is meant by boundary layer and hence define the following: i) Boundary layer thickness ii) Displacement thickness.	**6**	**L2**	**CO4**
	c.	State and explain Buckingham's π theorem.	**6**	**L2**	**CO4**
		OR			
Q.8	**a.**	What is similitude? Explain the different types of similitude.	**7**	**L2**	**CO4**
	b.	Explain the dimentional homogeneity with examples.	**3**	**L2**	**CO4**

	c.	The frictional torque (T) of a disc of diameter (D) rotating at a speed (N) in a fluid of viscosity (μ) and density (ρ) in a turbulent flow is given by $T = D5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by Buckingham's - π theorem.	10	L3	CO4
		Module – 5			
Q.9	a.	Define Mach number. Explain the significance of Mach number in compressible fluid flow.	6	L2	CO5
	b.	Derive an expression for velocity of sound wave in a fluid.	8	L2	CO5
	c.	Find the velocity of bullet fired in standard air if Mach angle is 30°. Take R = 287.14 J/kg K and γ = 1.4 for air and temperature of air is 15°C.	6	L3	CO5
		OR			
Q.10	a.	An air plane is flying at an altitude of 15 km where the temperature is -50°C. The speed of plane corresponds to Mach number 1.6. Assume γ = 1.4 and R = 287 J/kg K for air. Find speed of plane and Mach angle.	8	L3	CO5
	b.	Define: i) Mach Number ii) Sub-Sonic flow iii) Sonic flow iv) Super-Sonic flow	4	L1	CO5
	c.	Mention the advantages and disadvantages of CFD.	8	L2	CO5

* * * * *