CBCS SCHEME

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BME403

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2026
Fluid Mechanics

ACHARYA INSTITUTE OF TECHNOLOGY LIBRARY BANGALORE

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 terms with SI units : i) Weight Density ii) Viscosity iii) Compressibility iv) Capillarity	08	L1	CO1
	b.	The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The diameter of the shaft is 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm.	08	L3	CO1
	c.	Classify the Manometers.	04	L1	CO1
		OR			
Q.2	a.	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 specific gravity 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.	08	L3	CO1
	b.	Derive an expression for total pressure force and centre of pressure on a vertical plane surface immersed in static fluid.	08	L3	CO1
	c.	Define the following terms: (i) Total Pressure (ii) Centre of Pressure	04	L1	CO1
		Module – 2			
Q.3	a.	Differentiate between : (i) Steady and Unsteady Flow (ii) Uniform and Non-uniform Flow (iii) Laminar and Turbulent Flow	06	L2	CO2
	b.	Derive the 3-dimensional flow continuity equation in Cartesian coordinates.	08	L3	CO2
	c.	The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4, 5).	06	L3	CO2
		OR			
Q.4	a.	Derive the Hagen Poiseulle equation for laminar flow through a circular pipe.	12	L3	CO2
	b.	A crude oil of viscosity 0.9 poise and specific gravity 0.8 is flowing through a horizontal circular pipe of diameter 80 mm and of length 15 m. Calculate the difference of pressure at the two ends of the pipe, if 50 kg of oil is collected in a tank in 15 seconds. Also calculate the loss of pressure head.	08	L3	CO2

		Module – 3			
Q.5	**a.**	Derive the Euler's equation of fluid motion and hence deduce Bernoulli's equation.	**10**	**L3**	**CO3**
	b.	Derive an expression for discharge over a triangular notch.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Mention any five minor energy loss with equations.	**05**	**L1**	**CO3**
	b.	Derive Darcy – Weisbach equation for determining loss of head due to friction.	**10**	**L3**	**CO3**
	c.	Water is flowing through a pipe of 100 mm diameter under a pressure of 19.62 N/cm^2 and with mean velocity of 3.0 m/s. Find the total head of the water at a cross section which is 8 m above the datum line.	**05**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the following terms: i) Boundary layer thickness ii) Streamline body iii) Bluff body iv) Lift v) Drag	**10**	**L2**	**CO4**
	b.	A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. The coefficient of drag and lift are 0.15 and 0.75 respectively. Compute : (i) List force (ii) Drag force (iii) Resultant force (iii) Power required to keep the plate in motion.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Explain the following terms: i) Reynold's number ii) Froude's number iii) Euler's number iv) Weber's number v) Mach's number	**10**	**L2**	**CO4**
	b.	The efficiency of fan depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Show that velocity of elastic wave propagation in an adiabatic medium is given by $C = \sqrt{kRT}$.	**10**	**L3**	**CO5**
	b.	A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and the Mach angle. Take K = 1.4 and R = 287 J/kg K.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Deduce an expression for velocity of sound wave in a fluid.	**10**	**L3**	**CO5**
	b.	Explain the necessity, applications and limitations of CFD.	**10**	**L2**	**CO5**

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