CBCS SCHEME

USN | | | | | | | | | | | **BME403**

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024
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.
3. Assume missing data suitably.

		Module – 1	M	L	C
Q.1	a.	Define the following properties of fluids and mention their S.I. units: (i) Weight density (ii) Surface tension (iii) Kinematic viscosity (iv) Compressibility	08	L2	CO1
	b.	The space between two square parallel plates is filled with an oil of relative density 0.95. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. It requires a force of 100 N to more the upper plate at a velocity of 2.5 m/s relative to the lower fixed plate. Determine: (i) The dynamic viscosity of oil in Pa-s (ii) Kinematic viscosity of oil	08	L3	CO1
	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 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 limb is 20 cm.	04	L3	CO1
		OR			
Q.2	a.	State and prove Pascal's law.	05	L2	CO1
	b.	Derive an expression for the total pressure and the depth of centre of pressure for a vertical surface submerged in water.	08	L3	CO1
	c.	Find the total pressure and position of centre of pressure on a triangular plate of base 2 m and height of 3m which is immersed in water in such a way that the plan of the plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface.	07	L3	CO1
		Module – 2			
Q.3	a.	Explain different types of fluid flow.	06	L2	CO2
	b.	Derive continuity equation in Cartesian coordinate for a fluid flow in 3 dimensions.	08	L3	CO2
	c.	The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ.	06	L3	CO2
		OR			
Q.4	a.	Show that for viscous flow through a circular pipe, the maximum velocity is twice the average velocity.	08	L3	CO2
	b.	A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2, find: (i) The pressure gradient (ii) The average velocity (iii) Reynold number of the flow	08	L3	CO2
	c.	Define Reynolds number. Explain its significance in fluid flow.	04	L2	CO2

			Marks	Level	CO
		Module – 3			
Q.5	**a.**	Obtain the Euler's equation of motion along a stream line. Obtain Bernoulli's equation. Mention the assumption made.	**08**	**L3**	**CO3**
	b.	Derive an expression for discharge through a rectangular notch.	**06**	**L3**	**CO3**
	c.	An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$.	**06**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive Darcy-Weisbach equation for loss of head due to friction in pipe.	**08**	**L3**	**CO3**
	b.	Derive an expression for the loss of head due to the sudden enlargement in pipe.	**06**	**L3**	**CO3**
	c.	What are the energy losses that occur in pipe? Give the expressions for different minor energy losses.	**06**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Define the drag force and lift force. Also derive their expressions.	**10**	**L3**	**CO4**
	b.	Briefly explain what is meant by boundary layer and hence define the following: (i) Boundary layer thickness (ii) Displacement thickness	**06**	**L2**	**CO4**
	c.	Explain what is stream-lined body and bluff body.	**04**	**L2**	**CO4**
		OR			
Q.8	**a.**	What is dimensional homogeneity? Explain with examples.	**04**	**L2**	**CO4**
	b.	What is similitude? Explain the following : (i) Geometric similarity (ii) Dynamic similarity (iii) Kinematic similarity	**08**	**L2**	**CO4**
	c.	Show by Buckingham's π theorem that the frictional torque 'T' of a disc of diameter 'D' rotating at speed N in a fluid of viscosity 'μ' and density 'ρ' in a flow is given by $T = D^5N^2\rho\phi\left[\dfrac{\mu}{D^2N\rho}\right]$	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Show that velocity of propagation of elastic wave in an adiabatic medium is given by $C = \sqrt{KRT}$ starting from fundamentals.	**10**	**L3**	**CO5**
	b.	An air plane is flying at an altitude of 15 km where the temperature is –50°C. The speed of the plane corresponds to Mach number of 1.6. Assume K = 1.4 and R = 287 J/kgK for air, find the plane speed and Mach angle.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Define the following terms: (i) Subsonic flow (ii) Sonic flow (iii) Supersonic flow (iv) Mach number (v) Mach angle	**10**	**L2**	**CO5**
	b.	Explain the necessity of CFD. Mention its advantages, limitations and its applications.	**10**	**L2**	**CO5**

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