CBCS SCHEME

USN | | | | | | | | | |

BAE/BAS303

Third 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.	Derive an expression for total pressure force and depth of pressure for a vertical surface submerged in water.	10	L3	CO1
	b.	Two larger plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerine. What force is required to drag a very thin plate of surface area 0.5 m^2 lying between two large planes and moving at a velocity of 0.6 m/s, if (i) Thin plate is in the middle of two plane surfaces (ii) The thin plate is at a distance of 0.8 cm from one of the plane surfaces. Given dynamic viscosity of glycerine is 8.10×10^{-1} NS/m^2.	10	L3	CO3
		OR			
Q.2	a.	State and prove Pascal's law.	10	L3	CO1
	b.	The right limb of a simple U-tube manometer contains mercury which is open to atmosphere, while the left limb is connected to a pipe in which a fluid of S.G = 0.9 is flowing. The center of the pipe is 12 cm below the level of Hg in the right limb. Find the pressure of fluid in the pipe, if the difference of Hg level in the 2 limbs is 20 cm.	10	L3	CO3
		Module – 2			
Q.3	a.	Define velocity potential and stream function and write its expression for vlocity components. Prove that product of the equipotential lines and stream lines is (–1).	10	L3	CO2
	b.	The stream function for the 2D flow is given by $\psi = 2xy$, calculate the velocity at point (1, 2). Find the velocity potential function ϕ.	10	L3	CO2
		OR			
Q.4	a.	Derive the momentum equation in integral form for 3D steady incompressible viscous flow.	10	L3	CO2
	b.	Derive the expression for continuity equation in three dimensional flow. Also check the possible case of fluid flow, $U = \left(\frac{y^3}{3} + 2x - x^2 y\right)$, $V = \left(y^2 x - 2y - \frac{x^3}{3}\right)$.	10	L3	CO2
		Module – 3			
Q.5	a.	Derive Euler's equation and using that derive the Bernoulli's equation. Also write the assumptions made for it.	10	L3	CO2
	b.	Water is flowing through a pipe having diameter 300 mm and 200 mm at bottom and upper respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at upper end is 9.81 N/cm^2. Determine the difference in datum head, if rate of flow through pipe is 40 lit/sec.	10	L3	CO2

		OR			
Q.6	**a.**	Sketch and explain source-sink pair combination flow.	**10**	L2	CO1
	b.	Derive the expression for rate of flow through venturimeter. An oil of specific gravity 0.8 is flowing through venturimeter. The oil-mercury differential manometer shows a reading of 25 cm. Calculate the difference of pressure head.	**10**	L3	CO2
		Module – 4			
Q.7	**a.**	Define and derive the expression for the following numbers: (i) R_e (ii) F_e (iii) E_u (iv) W_e (v) M	**10**	L1	CO1
	b.	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness K. Using Buckingham's π theorem obtain an expression for ΔP.	**10**	L2	CO2
		OR			
Q.8	**a.**	Derive the expression for drag on flat plate due to boundary layer and write its application.	**10**	L1	CO1
	b.	Find the displacement thickness, momentum and energy thickness for the velocity distribution $\frac{u}{U_d} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$.	**10**	L3	CO2
		Module – 5			
Q.9	**a.**	Define the following terms: (i) Mach number (ii) Mach line (iii) Mach angle (iv) Zone of action (v) Zone of silence	**10**	L2	CO3
	b.	Derive the expression for Bernoulli's equation for adiabatic process.	**10**	L3	CO3
		OR			
Q.10	**a.**	Derive an expression for velocity of sound work in fluid.	**10**	L2	CO3
	b.	An aircraft is flying at 950 km/hr through still air having an absolute pressure of 80 kN/m^2 and temperature –7°C. Calculate stagnation pressure, stagnation temperature and stagnation density on the stagnation point on the nose of the plane. Take R = 287 J/kg.K and γ = 1.4 for air.	**10**	L3	CO3

* * * * *