CBCS SCHEME

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BME403

Fourth Semester B.E./B.Tech. Degree Supplementary 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. Draw the sketches wherever necessary.

		Module – 1	M	L	C
Q.1	a.	Define the following fluid properties: i) Mass Density ii) Specific Gravity iii) Surface tension.	6	L2	CO1
	b.	State and prove the Pascal's law for the intensity of pressure in a static fluid.	6	L2	CO1
	c.	Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m × 0.8m and an inclined plane with angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of oil film is 1.5 mm. Also, determine the kinematic viscosity of oil if the specific gravity of oil is 0.85.	8	L3	CO1
		OR			
Q.2	a.	Derive an expression for "Total Pressure" and "Center of Pressure" acting on vertical plane surface submerged in a static liquid.	10	L2	CO1
	b.	A differential manometer using mercury as manometric fluid is connected to two pipes A and B. Water flows through pipe A and a liquid of specific gravity 0.9 flows through pipe B. Pipe B is 1.5 m above the level of pipe A. Meniscus of mercury in the left limb connected to A is 3m below the center of pipe A and Meniscus on the right limb connected to pipe B is 10 cm above that in the left limb. If the pressure in pipe A is 10 bar, determine the pressure in pipe B. Sketch the manometer arrangement.	10	L3	CO1
		Module – 2			
Q.3	a.	Write a note on the following types of fluid flow: i) Steady and unsteady flow ii) Uniform and Non uniform flow iii) Laminar and turbulent flow.	6	L2	CO2
	b.	Obtain an expression for continuity equation in Cartesian coordinate system for a 3-dimensional fluid flow.	8	L2	CO2
	c.	A fluid flow field is given by $V = x^2yi + y^2zj - (2xyz + yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity of the fluid at the print (2, 1, 3).	6	L3	CO2

		OR			
Q.4	**a.**	Derive an expression for the velocity distribution and shear stress distribution for the viscous flow through a circular pipe. Show the velocity and shear-stress distribution across the circular pipe.	10	L2	CO2
	b.	Calculate : i) Pressure gradient along flow ii) The average velocity iii) The discharge for an oil of. Viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2m/s.	10	L3	CO2
		Module – 3			
Q.5	**a.**	Derive the Euler's equation of motion for the fluid flowing along a stream line. Obtain Bernoullis equation of motion and mention the assumptions made.	10	L2	CO3
	b.	A 30 cm × 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the ventirumeter is 30 cm. The differential U-tube mercury manometer shows a deflection of 25 cm. Determine: i) The discharge of oil ii) The pressure difference between the entrance section and the throat section. Take C_d of venturimeter as 0.98 and specific gravity of mercury as 13.6.	10	L3	CO3
		OR			
Q.6	**a.**	Derive the Daray-Weisbach equation for the loss of head due to friction in a pipe.	10	L2	CO3
	b.	The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine: i) Loss of head due to sudden enlargement. ii) Pressure intensity in the large pipe. iii) Power lost due to enlargement.	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.	What do you mean by boundary layer? Explain the following with a boundary layer diagram. i) Boundary layer thickness ii) Displacement thickness.	6	L2	CO4
	c.	A man weighing 90 kgf descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute which is hemispherical in shape, come down is 20 m/s. Find the diameter of the parachute. Assume C_b = 0.5 and density of air = 1.25 kg/m^3.	6	L3	CO4

		OR			
Q.8	**a.**	Write the dimensions of the following quantities: i) Kinematic viscosity ii) Dynamic viscosity iii) Discharge/Rate of flow iv) Specific weight.	4	L2	CO4
	b.	Explain the following dimensionless numbers: i) Reynold's number ii) Mach number iii) Weber number.	6	L2	CO4
	c.	Using Buckingham's π-theorem, prove that 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. $T = D^5N^2\rho\ \phi\left[\frac{\mu}{D^2N\rho}\right]$	10	L3	CO4
		Module – 5			
Q.9	**a.**	Derive an expression for the velocity of sound wave in terms of change of pressure and change of density.	8	L2	CO5
	b.	Define Mach number. Explain its significance in compressible fluid flow.	6	L2	CO5
	c.	Calculate the speed of the aeroplane flying at an height of 15 km where the temperature is -50°C. The speed of the plane is corresponding to mach number equal to 2. Assume K = 1.4 and R = 287 J/kg K.	6	L3	CO5
		OR			
Q.10	**a.**	Derive an expression for velocity of sound in compressible fluid medium undergoing. i) An isothermal processes ii) An adiabatic process.	8	L2	CO5
	b.	Mention the advantages and disadvantages of CFD.	6	L2	CO5
	c.	Discuss the applications of CFD in various domain of industry and academia.	6	L2	CO5

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