U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

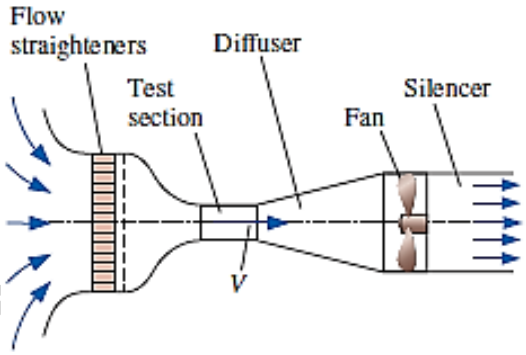
October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME4PCFME **Max Marks: 100**
Course: Fluid Mechanics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Derive Pascal's law and prove that pressure is same at all points in a fluid at rest.	CO1	PO1	**06**
	b)	A U tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. Also sketch the arrangement of mercury and fluid in manometer.	CO1	PO2	**08**
	c)	Define the terms and write their appropriate relation; i) capillarity, ii) vapor pressure, and iii) surface tension.	CO1	PO1	**06**
		UNIT - II			
2	a)	Define the following with appropriate line diagram and formula if applicable; i) Turbulent flow, ii) Rotational Flow, iii) Streak Lines, iv) Uniform flow, and v) Path lines.	CO2	PO1	**10**
	b)	A Venturi meter is used for measurement of discharge of water in a horizontal pipe line. If the ratio of upstream pipe diameter to that of throat is 2:1, upstream diameter is 300 mm, the difference of pressure between the throat and upstream is equal to 3 m head of water and loss of head through meter is one eighth of the throat velocity head, calculate discharge in the pipe.	CO2	PO2	**10**
		OR			
3	a)	Derive the Euler's equation of motion along a stream line and also obtain Bernoulli's equation from it. List the assumptions.	CO2	PO1	**10**
	b)	An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm mercury. Find the rate of flow of oil of specific gravity 0.9 when the co-efficient of discharge of the meter is 0.64.	CO2	PO2	**10**

			UNIT - III			
	4	a)	Derive 2D Navier-Stokes equations for a laminar flow condition.	*CO3*	*PO1*	**10**
		b)	A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe.	*CO3*	*PO2*	**06**
		c)	Write Reynold's transport theorem (RTT) relation and explain each term.	*CO3*	*PO1*	**04**
			OR			
	5	a)	Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow.	*CO3*	*PO1*	**10**
		b)	A small low-speed wind tunnel (Fig.3) is being designed for calibration of hot wires. The air is at 19°C. The test section of the wind tunnel is 30 cm in diameter and 30 cm in length. The flow through the test section must be as uniform as possible. The wind tunnel speed ranges from 1 to 8 m/s, and the design is to be optimized for an air speed of V = 4.0 m/s through the test section. (a) For the case of nearly uniform flow at 4 m/s at the test section inlet, by how much will the centerline air speed accelerate by the end of the test section? Take $\nu = 1.507\times10^{-5}$ m²/s  Fig.3	*CO5*	*PO2*	**10**
			UNIT - IV			
	6	a)	What is boundary layer flow? Define; boundary layer thickness, momentum thickness and displacement thickness with their appropriation relations.	*CO3*	*PO1*	**10**
		b)	Velocity profile for laminar boundary layer flows is $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$. Find the thickness of boundary layer at the end of the plate and the drag force on one side of a plate 1.2 m long and 0.8 m wide. If the laminar boundary layer exists up to a value Re = $2\text{x}10^5$, find the maximum thickness of laminar boundary layer. Assume kinematic viscosity of air as 0.15 stokes.	*CO3*	*PO2*	**10**
			UNIT - V			
	7	a)	List the various dimensionless numbers corresponds to fluid	*CO4*	*PO1*	**10**

			flow, also define the significance of any four dimensionless numbers.			
		b)	An xyz company is designing a fan which gives highest efficiency. Suggest them, efficiency of fan in terms of dimensionless parameters. Consider the fan efficiency (η) depends on density of air (ρ), dynamic viscosity of fluid (μ), angular velocity (ω), diameter of fan (D) and the discharge (Q). Consider D, ω and ρ are the repeating variables.	*CO4*	*PO2*	**10**

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