U.S.N.										

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

Autonomous Institute Affiliated to VTU

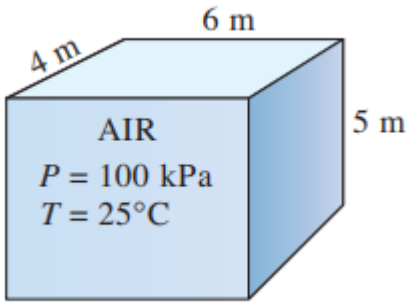
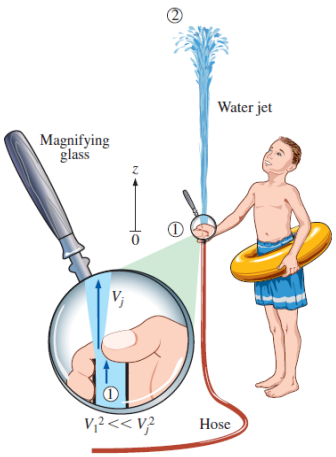
October 2024 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 23AS3PCFMS **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)	Define the following i) Metacentric height ii) Buoyancy iii) Centre of pressure iv) Vapour pressure and cavitation v) Newtonian and non-Newtonian fluid	*CO 1*	*PO 1*	**10**
	b)	The pressure outside the droplet of water of diameter 0.04 mm is 10.32 N/cm^2 (atmospheric pressure). Calculate the pressure within the droplet if surface tension is given as 0.0725 N/m of water.	*CO 1*	*PO 1* *PO 2*	**4**
	c)	Consider the steady, two-dimensional velocity field, $\vec{V} = (u,v) = (0.5+0.8x)\hat{i} + (1.5-0.8y)\,j$ where, lengths are in units of meters (m), time in seconds (s), and velocities in meter/second (m/s). Calculate the various kinematic properties, namely, i) Rate of translation. ii) Rate of rotation. iii) Linear strain rate, shear strain rate and volumetric strain rate. iv) Verify if this flow is incompressible.	*CO 1*	*PO 1* *PO 2*	**6**
		OR			
2	a)	Derive an expression to find the magnitude of the resultant force (F_R) and the vertical location of the line of action of the resultant force (y_P) acting on a plane surface of a completely submerged plate in a homogeneous fluid. Deduce the magnitude of the resultant force (F_R) for the case where horizontal rectangular plate is completely submerged in a homogeneous fluid.	*CO 2*	*PO 1* *PO 2*	**10**
	b)	The surface tension of water in contact with air at 20^{o}C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N/cm^2	*CO 1*	*PO 1* *PO 2*	**10**

			greater than the outside pressure. Calculate the diameter of the droplet of water.  Figure1: Schematic for the problem 2b.			
			UNIT - II			
3	a)		Define i) Stream line, streak line and path line with a neat sketch ii) Lagrangian and Eulerian descriptions of fluid flow	*CO 1*	*PO 1* *PO 2*	**10**
	b)		The following cases represent the two velocity components, determine the third velocity component such that they satisfy the continuity equation- $u = x^2 + y^2 + z^2; v = xy^2 - yz^2 + xy$ $v = 2y^2; w = 2xyz$	*CO 1*	*PO 1* *PO 2*	**10**
			UNIT - III			
4	a)		Differentiate between Venturi meter and Orifice meter with neat sketches.	*CO 4*	*PO 1* *PO 4*	**6**
	b)		Describe different types of notches that are used in open channels? Based on your understanding, in which type of notch, the discharge would be higher?	*CO 4*	*PO 1*	**6**
	c)		Water is flowing from a garden hose (Figure 2). A child places his thumb to cover most of the hose outlet, causing a thin jet of high-speed water to emerge. The pressure in the hose just upstream of his thumb is 400 kPa. If the hose is held upward, what is the maximum height that the jet could achieve?  Figure 2: Schematic for the problem 4c. Insert shows a magnified view of the hose outlet region.	*CO 2*	*PO 1* *PO 2*	**8**

			UNIT – IV			
	5	a)	Perform the order of magnitude analysis for boundary layer equations (continuity, x-momentum and y-momentum equation), showing how inertia and viscous term behave with pressure gradient.	*CO 2*	*PO 1* *PO 2*	**14**
		b)	Define and write the expressions for displacement, momentum and energy boundary layer thicknesses.	*CO 1*	*PO 1* *PO 2*	**6**
			OR			
	6	a)	Deduce an expression for the Hagen-Poiseuille equation considering viscous fluid flow through a circular pipe of diameter D, radius r_o with flow properties density ρ, pressure P.	*CO 2*	*PO 1* *PO 2*	**14**
		b)	Analyze the displacement thickness, the momentum thickness and for the velocity distribution in the boundary layer given by $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$.	*CO 1*	*PO 1* *PO 2*	**6**
			UNIT - V			
	7	a)	Write down in detail description of the six steps that comprise the method of repeating variables.	*CO 3*	*PO 1* *PO 2*	**12**
		b)	The aerodynamic drag of a new sports car is to be predicted at a speed of 50.0 mi/h at an air temperature of 25°C. Automotive engineers build a one-fifth scale model of the car to test in a wind tunnel. It is winter and the wind tunnel is located in an unheated building; the temperature of the wind tunnel air is only about 5°C. Determine how fast the engineers should run the wind tunnel in order to achieve similarity between the model and the prototype.	*CO 3*	*PO 1* *PO 2*	**8**

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