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

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 22AS3PCFMS **Max Marks: 100**
Course: Fluid Mechanics Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Scientific calculator and steam data handbook are allowed to use.

UNIT - I

1 a) Explain Newton's law of viscosity. **05**

b) Define i) Vapour pressure ii) Capillarity. **05**

c) If the velocity of the fluid over a flat plate is parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/s. Calculate the velocity gradient and shear stresses at a distance of 0, 10 and 20 cm from the plate, if the viscosity of the fluid is 0.85 N-s/m^2. **10**

OR

2 a) State and Prove Pascal's law. **10**

b) A differential manometer is connected at the two points A and B of two pipes as shown in the Fig. 1. The pipe A contains a liquid of specific gravity 1.5 while the pipe B contains a liquid of specific gravity 0.9. The pressures at A and B are 98,100 N/m^2 and 1,76,580 N/m^2 respectively. Find the difference in the mercury level in the differential manometer. **10**

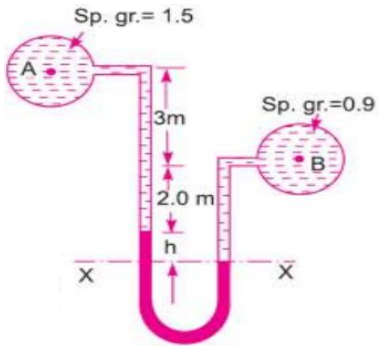

Fig. 1: Differential U tube Manometer

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 - II

3 a) The velocity vector in a fluid flow is given by **10**

$$V = 4x^3\,\vec{i} - 10x^2y\vec{j} + 2t\vec{k}$$

Find the velocity and the acceleration of the fluid particle at (2, 1, 3) at t = 1.

b) Derive the expression for the continuity equation in three dimensions. **10**

UNIT - III

4 a) Explain the differences between an orifice meter and the venturi meter with a neat sketch. **10**

b) Using Buckingham's pi theorem, find an expression for the power P, developed by a pump when P depends upon the head H, the discharge Q and specific weight *w* of the fluid. **10**

UNIT - IV

5 a) Derive the Hagen-Poiseuille flow for circular pipes. **12**

b) Define (i) Displacement thickness, (ii) Momentum thickness and (iii) Energy thickness. **08**

UNIT - V

6 a) A thin rectangular plate having width w and a height h is located so that it is normal to a moving stream of fluid. Assume the drag D, that the fluid exerts on a plate is a function of w and h, the fluid viscosity and density μ and ρ respectively and the velocity of the fluid V approaching the plate. Determine the suitable set of pi terms and the related expression to study this problem? (Use w, V and ρ are repeating variables). **10**

b) What are bluff bodies? Derive an expression for co-efficient of drag for any bluff body. **10**

OR

7 a) Find the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$ Where u is the velocity at a distance y from the plate $u = U$ at $y = \delta$ and is boundary layer thickness. **10**

b) The pressure drop in an aeroplane model of size $\frac{1}{10}$ of its prototype is 80 $\frac{N}{cm^2}$. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air as 1.24 $\frac{kg}{m^3}$. The viscosity of water is 0.01 $poise$ while the viscosity of air is 0.00018 $poise$. **10**

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