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

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: III**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 22CH3PCFME **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.

UNIT - I

1 a) A simple manometer is used to measure the pressure drop across an orifice. Liquid A is mercury (density 13,590 kg/m^3) and fluid B, flowing through the orifice and filling the manometer leads, is brine (density 1,260 kg/m^3). When the pressure at the taps are equal, the level of the mercury in the manometer is 0.9 m below the orifice taps. Under operating conditions, the gauge pressure at the upstream tap is 0.14 bar; the pressure at the downstream tap is 250 mm Hg below atmospheric. What is the reading of the manometer in millimeters? **06**

b) Derive the expression for variation of pressure with height under isothermal conditions in a static fluid, when the fluid is an (i) incompressible fluid (ii) compressible fluid **10**

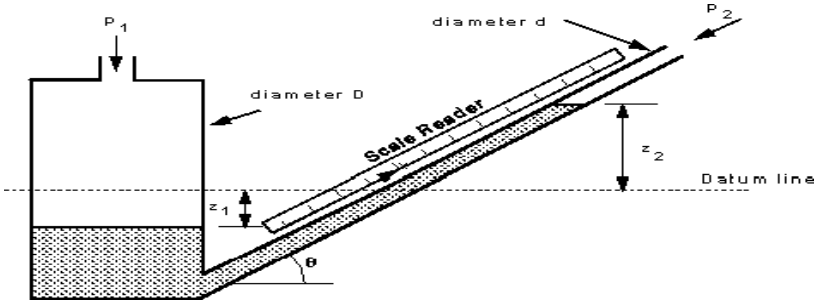
c) If the atmospheric pressure at sea level is 101430 N/m^2, determine the pressure at a height of 2500 m, assuming that the pressure variation follows Hydrostatic law. The density of air is given as 1.208 kg/m^3. **04**

OR

2 a) An inclined tube manometer consists of a vertical cylinder 35 mm diameter. The bottom of this is connected to a tube 5 mm in diameter inclined upward at an angle of 15 to the horizontal. The top of the inclined tube is connected to an air duct. The vertical cylinder is open to the air and the manometric fluid has relative density 0.785. **06**

i) Determine the pressure in the air duct if the manometric fluid moved 50mm along the inclined tube.

ii)What is the error if the movement of the fluid in the vertical cylinder is ignored?



b) Explain Newtonian and non-Newtonian fluids with a graph of shear stress and velocity gradient. **10**

c) If the equation of a velocity profile over a plate is $u = 5y^2 + y$ (Where u is the velocity in m/s., determine the shear stress at y=0 and at y = 7.5 cm. Given the viscosity of the liquid is 8.35 poise. **04**

UNIT - II

3 a) Enlist the three different correction factors for Bernoulli's equation. Write the Bernoulli's equation modified with the correction factors. **06**

b) Acid slurry of 0.7×10^{-3} m^3/s is to be pumped through a 50 mm diameter pipe, 30 m long to a tank and 12 m higher than its reservoir. The frictional losses amount to 3 m and efficiency of the pump is 50%. Calculate (i) Power required to pump the acid and (ii) Pressure developed by the pump.
Data: Density of the acid slurry ρ_{Acid}= 1840 kg/m^3 and Viscosity of Acid μ_{Acid}=0.025 Ns/m^2 **10**

c) Explain friction factor chart with a neat diagram. **04**

OR

4 a) Derive the expression for Euler's equation and integrate it to obtain Bernoulli's equation. State the assumptions made. **12**

b) Air at 20°C and 2 atm absolute pressure enters a finned tube steam heater through a 50 mm tube at an average velocity of 15 m/s. It leaves the heater through a 65 mm tube at 90°C and 1.6 atm absolute. What is the average air velocity at the outlet? **08**

UNIT - III

5 a) List any three different basic equations used for compressible fluid flow. **06**

b) Derive Bernoulli's equation for adiabatic process conditions of compressible fluid flow. **10**

c) Find the sonic velocity of the following fluid. (i) Crude oil of specific gravity 0.8 and bulk modulus 153036 N/cm^2 (ii) Mercury having a bulk modulus of 2648700 N/cm^2. **04**

UNIT - IV

6 a) Explain the work done by the impeller of a centrifugal pump on the liquid. **10**

b) Explain the following terms: (i) Net positive suction head (ii) Pump efficiency (iii) Priming (iv) Cavitation **10**

UNIT – V

7 a) 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 $T = D^5 N^2 \rho \phi \left[\frac{\mu}{D^2 N \rho} \right]$. Prove this by Buckingham-π method of dimensional analysis. **12**

b) Briefly explain any two of the following **08**
   i. Geometric similarity
   ii. Kinematic similarity
   iii. Dynamic similarity

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