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BME–028

B. TECH. IN MECHANICAL ENGINEERING (CIM) (BTME)

Term-End Examination

December, 2019

BME-028 : FLUID MECHANICS

Time : 3 Hours *Maximum Marks : 70*

Note : *Attempt any seven questions. All questions carry equal marks. Use of Scientific calculator is permitted. Assume missing data if any, suitably. All the notations have their usual meaning.*

1. (a) How the U-tube manometer is used for the measurement of fluid pressure ? Explain with a neat sketch. 5

   (b) Calculate the specific weight, density and specific gravity of one litre of liquid which weighs 7 N. 5

2. (a) A plate 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N per unit area i.e., 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates. 5

   (b) Differentiate between dynamic viscosity and kinematic viscosity. Write their units of measurement. 5

3. (a) Discuss the importance of viscosity in fluid motion. What is the effect of temperature on viscosity of water and that of air ? 5

   (b) Find the kinematic viscosity of an oil having density 981 kg/m^3. The shear stress at a point in oil is 0.2452 N/m^2 and velocity gradient at that point is 0.2 per second. 5

4. (a) Calculate the pressure of air at a height of 7500 m above sea level if the atmospheric pressure is 10.143 N/cm^2 and temperature is 15°C at sea level, assuming : 5

   (i) Air is incompressible.

   (ii) Pressure variation follows isothermal law.

(iii) Pressure variation follows adiabatic law.

Take the density of air at sea level as equal to 1.285 kg/m^3. Neglect variation of g with altitude. $g = 9.81 N/m^2$.

(b) State the Pascal's law. Explain pressure variation in fluid at rest. 5

5. (a) Define the terms 'buoyancy' and 'centre of buoyancy'. Derive an expression for the metacentric height of a floating body. 5

(b) A solid cylinder of 10 cm diameter and 40 cm long consists of two parts made of different materials. The first part at the base is 1.0 cm long and of specific gravity 6.0. The other part of the cylinder is made of the material having specific gravity 0.6. State whether it can float vertically in water or not. 5

6. (a) Distinguish between the following : 5

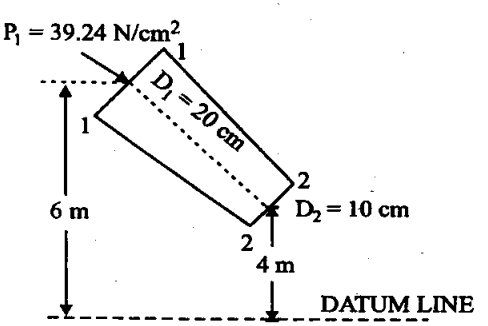
(i) Steady flow and Unsteady flow

(ii) Laminar and Tubulent flow

(b) A 30 cm diameter pipe, carrying water, branches into two pipes of diameter 20 cm and 15 cm respectively. If the average velocity in 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s. 5

7. (a) State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for the derivation. 5

(b) The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and section 2 respectively. The rate of flow through pipe is 35 litre/s. The section 1 is 6 m above datum and section 2 is 4 m above the datum. If the pressure at section 1 is 39.24 N/cm^2, find the intensity of pressure at section 2. 5



8. A fluid of density ρ and viscosity μ, flows at an average velocity V through a circular pipe of diameter D. Show by "dimensional analysis", that the shear stress at the pipe wall is given as : 10

$$\tau_0 = \rho V^2 \phi \left[\frac{\rho VD}{\mu} \right]$$

9. Write short notes on any two of the following : 5+5

(a) Discharge over a triangular notch

(b) Equivalent pipe length

(c) Physical significance of Reynolds number and Froude number