CBCS SCHEME

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18IP35

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following terms with their units:
   i) Capillarity
   ii) Surface tension
   iii) Mass density
   iv) Pressure intensity
   v) Kinematic viscosity. **(10 Marks)**

b. Derive the relation for pressure intensity and the surface tension in case of a soap bubble. **(04 Marks)**

c. A differential manometer is connected at the two points A and B as shown in Fig.Q.1(c). At 'B' air pressure is 9.81×10^4 N/m^2 (abs). Find the absolute pressure at A. **(06 Marks)**

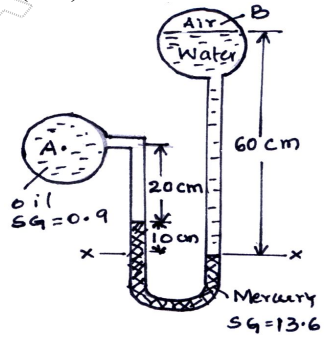

Fig.Q.1(c)

OR

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive an expression for total pressure and centre of pressure on an inclined plane surface submerged in liquid. **(08 Marks)**

c. Define vapour pressure and cavitation. **(06 Marks)**

Module-2

3 a. Define the following:
   i) Buoyancy
   ii) Centre of Buoyancy
   iii) Meta centre
   iv) Meta centric height. **(08 Marks)**

b. Explain the conditions for stability of submerged and floating bodies. **(06 Marks)**

c. A rectangular pontoon is 5m long, 3m wide and 1.20m high. The depth of immersion of the pontoon is 0.80m in sea water. If the centre of gravity is 0.6m above the bottom of the pontoon, determine the meta centric height. The density for sea water = 1025kg/m^3. **(06 Marks)**

OR

4 a. Differentiate between:
   i) Steady flow and Unsteady flow
   ii) Laminar and Turbulent flow
   iii) Stream line and Streak line
   iv) Rotational and Irrotational flow. **(08 Marks)**

   b. Derive the continuity equation for a 3D fluid flow in Cartesian coordinates. **(08 Marks)**

   c. A 25cm diameter pipe carries oil of specific gravity 0.9 at a velocity of 3m/s. At another section the diameter is 20cm. Find the velocity at this section and also mass flow rate of flow of oil. **(04 Marks)**

Module-3

5 a. Derive the Bernoulli's energy equation from Euler's motion equation. Mention clearly the assumptions made on the derivation. **(08 Marks)**

   b. A pipe through which water is flowing is having diameters 20cm and 10cm at the cross sections 1 and 2 respectively. The velocity of water at section 1 is given 4.0m/s. Find the velocity head at sections 1 and 2 and also rate of discharge. **(06 Marks)**

   c. Determine the height of a rectangular notch of length 6m to be built across a rectangular channel, the maximum depth of water on the upstream side of the notch is 1.8m and discharge is 2000 litres/sec. Take $C_d = 0.6$ and neglect end contractions. **(06 Marks)**

OR

6 a. Derive an expression for discharge through orifice meter. **(06 Marks)**

   b. A pitot-static tube placed on the centre of a 300mm pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.80 of the central velocity. Find the discharge through the pipe if the pressure difference between the two orifice is 60mm of water. Take C_v of pitot tube as 0.98. **(04 Marks)**

   c. A 30cm × 15cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9 the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30cm. The differential U-tube mercury manometer shows a gauge deflection of 25cm. Calculate: i) Discharge of oil and ii) The pressure difference between the entrance section and the throat section. Take C_d of meter = 0.98. **(10 Marks)**

Module-4

7 a. Derive Darcy-Weisback expression for friction head loss in a pipe flow. **(10 Marks)**

   b. A horizontal pipe line 40m long is connected to a water tank at one end and discharges freely on to the atmoshphere at the other end. For the first 25m of its length form the tank, the pipe is 150mm diameter and its diameter suddenly enlarged to 300mm. The height of water level in the tank is 8m above the centre of the pipe. Considering all losses of head which occur, Determine the rate of flow. Take f = 0.01 for both sections of the pipe. **(10 Marks)**

OR

8 a. Define the term Drag and Lift. Derive the expression for the same. **(10 Marks)**

   b. Air is flowing over a flat plate 500mm long and 600mm wide with a velocity of 4m/s. The kinematic viscosity of air is given as $0.15 \times 10^{-4} m^2/s$. Find:
   i) The boundary layer thickness at the end of the plate
   ii) Shear stress at 200mm from the leading edge
   iii) Drag force on one side of the plate.

   Take the velocity profile over the plate as $\frac{u}{U} = \sin\left[\frac{\pi}{2}.\frac{y}{\delta}\right]$ and density of air $1.24 kg/m^3$ **(10 Marks)**

Module-5

9 a. Explain the dimensional homogeneity. **(04 Marks)**

b. What is similitude and explain the types of similarities. **(08 Marks)**

c. State and explain Buckingham's π theorem. **(08 Marks)**

OR

10 a. Explain with their significance
i) Mach Number ii) Mach Angle iii) Mach Cone. **(06 Marks)**

b. Obtain an expression for velocity of sound wave in compressible fluid in terms of change in pressure and density. **(08 Marks)**

c. An aeroplane is flying at an height of 15km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming k = 1.4 and R = 287J/kg K. Find the speed of the plane. **(06 Marks)**

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