CBCS SCHEME

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17AU42

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define the following giving mathematical:
   i) Mass Density
   ii) Weight Density
   iii) Specific Volume
   iv) Specific gravity **(10 Marks)**

b. Two large plane surface are 2.4cm apart. The space between the surface is filled with glycerine. What force is required to drag a very thin plate of surface area 0.5 square metre between the two large plane surfaces at a speed of 0.6m/s if:
   i) The thin plate is in middle of the two plane surfaces
   ii) The thin plate is at a distance of 0.8cm from one of the plane surfaces? Take the dynamic viscosity of glycerine = 8.10×10^{-1} NS/m^2. **(10 Marks)**

2 a. State and explain hydrostatic law. **(10 Marks)**

b. A differential monometer is connected at the two point A and B of two pipes as shown in Fig.Q.2(b). The pipe A contains a liquid of sp.gr = 1.5 while pipe B contains a liquid by sp. gr = 0.9. The pressure at A and B are 1kgf/cm^2 and 1.80kgf/cm^2 respectively. Find the difference in Mercury level in the differential manometer. **(10 Marks)**

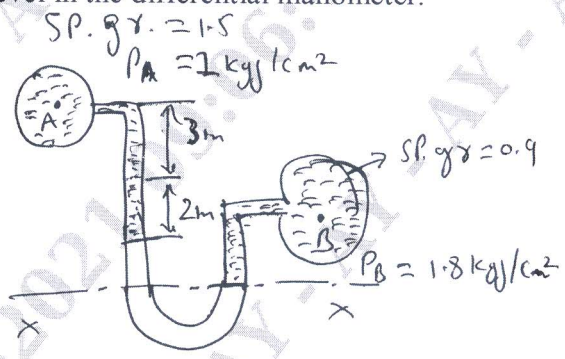

Fig.Q.2(b)

3 a. Define the terms:
   i) Buoyancy
   ii) Cetre of Buoyancy
   iii) Metacentre
   iv) Metacentric Height **(10 Marks)**

b. 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. **(10 Marks)**

4 a. Derive the continuity equation in the three dimensions in the differential form. **(10 Marks)**

b. The stream function for a two-dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point (2, 3). Find the velocity potential function ϕ. **(10 Marks)**

5 a. What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? **(10 Marks)**

b. The water is flowing through a pipe having diameter 20cm and 10cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at section 1 is $39.24N/cm^2$. Find the intensity of pressure at section 2. **(10 Marks)**

6 a. Derive expression for rate of flow through venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and down stream of the orifice meter gives reading of $19.62N/cm^2$ and $9.81N/cm^2$ respectively. Co-efficient of discharge for the meter is given as 0.6 find the discharge of water through pipe. **(10 Marks)**

7 a. Define following:

i) Reynolds Number (R_C)
ii) Froude's Number (F_C)
iii) Euler's Number (E_V)
iv) Mach's Number (M) **(10 Marks)**

b. 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

$$T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$$ **(10 Marks)**

8 a. Derive Darcy-Equation for loss of head due to friction in pipes. **(12 Marks)**

b. Write short notes on Hydraulic Gradient Line (H.G.L) and Total Energy Line (T.E.L). **(08 Marks)**

9 a. Derive laminar flow through circular pipe (Hagen-Poiseuille Equation). **(10 Marks)**

b. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(10 Marks)**

10 a. Define following terms:

i) Lift
ii) Drag
iii) Displacement thickness
iv) Momentum thickness. **(10 Marks)**

b. Define the terms:

i) Subsonic flow
ii) Supersonic flow. **(04 Marks)**

c. Find the velocity of bullet fired in standard air if the mach angle is 30° take R = 287.14 J/kg K and K = 1.4 for air assume temperature as 15°C. **(06 Marks)**

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