Third Semester B.E. Degree Examination, Aug./Sept.2020
Fluid Mechanics

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting at least TWO full questions from each part.*

PART – A

1 a. Define Viscosity. State Newton's law of viscosity. Give classification of fluids based on viscosity. Represent each type on a relevant diagram. **(10 Marks)**

   b. The dynamic viscosity of an oil. Used for lubrication between a shaft and sleeve is 0.6 N.S/m^2. The shaft is of 0.4m diameter and rotates at 190rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of the oil film is 1.5mm **(10 Marks)**

2 a. Sketch the following and show the height of liquid in the manometer tubes and write the equations for each case.
     i) Piezometer   ii) U-tube manometer for gauge pressure and vacuum pressure. **(12 Marks)**

   b. A rectangular plane surface is 2m wide and 3m deep. It lies in vertical plane in water. Determine the total pressure and position of center of pressure on the plane surface when its upper edge is horizontal and   i) Coincides with water surface   ii) 2.5m below the free surface of water. **(08 Marks)**

3 a. Explain stability of (conditions of equilibrium) of i) Floating and   ii) Submerged bodies with simple sketches. **(12 Marks)**

   b. Define stream function and potential function. Mention their properties and obtain relationship between them. **(08 Marks)**

4 a. Obtain: i) Euler's equation and   ii) Bernoulli's equation from fundamentals. **(12 Marks)**

   b. Water is flowing through a pipe of 5cm diameter under a pressure of 29.4N/cm^2 (gauge) and with mean velocity of 2.0m/s. Find the total heat or total energy per unit weight of the water at a cross section, which is 5m above the datum line. **(08 Marks)**

PART – B

5 a. Explain the three types of similarities with appropriate mathematical relationships. **(12 Marks)**

   b. An oil of sp. gr 0.8 is flowing through a venturimeter having inlet diameter 20cm and throat diameter 10cm. The oil-mercury differential manometer shows a reading of 25cm. Calculate the discharge of oil through the horizontal venturimeter. Take $C_d = 0.98$. **(08 Marks)**

6 a. Discuss energy losses during flow through a pipe and give their classification. **(08 Marks)**

   b. What do you mean by HGL and TEL? **(04 Marks)**

   c. Calculate the discharge through a pipe of diameter 200mm when the difference of pressure head between the two ends of a pipe 500m apart is 4m of water. Take f = 0.009. Use

$$h_f = \frac{4fLV^2}{2gd}.$$

(08 Marks)

7 a. Show that the velocity distribution across the section of a pipe is parabolic for viscous flow through a circular pipe. **(08 Marks)**

   b. Obtain Hagen-Poiseuille formula for viscous flow through a circular pipe given the average velocity as $\bar{u} = \dfrac{1}{8\mu}\left(-\dfrac{\partial P}{\partial x}\right)R^2$ **(06 Marks)**

   c. An oil of viscosity 0.1N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and of length 300m. The rate of flow is 3.5l/s. Find the pressure drop in a length of 300m. Take ρ_{oil} = 900 kg/m^3. **(06 Marks)**

8 a. Obtain an expression for velocity of sound or pressure wave in a fluid. **(12 Marks)**

   b. Define the following:
       i) Lift   ii) Drag   iii) Mach number and   iv) Mach cone. **(08 Marks)**

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