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10CV35

Third Semester B.E. Degree Examination, June 2012
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following fluid properties. Give their dimensions:
   i) Specific weight
   ii) Relative density
   iii) Specific volume
   iv) Dynamic viscosity
   v) Surface tension. **(10 Marks)**

   b. A 400 mm diameter shaft is rotating at 200 rpm in a bearing of length 100 mm. If the thickness of the oil film is 1.4 mm and the dynamic viscosity of the oil is 0.7 N-S/m^2. Determine.
   i) Torque required to over come friction in bearing.
   ii) Power utilized in overcoming viscous resistance. Assume a linear velocity profile. **(10 Marks)**

2 a. With the help of a neat sketch define the terms: Absolute, gauge and vacuum pressure. Bring out the relationship between absolute and gauge pressure. **(08 Marks)**

   b. List out the characteristics of Manometric liquids. Give any two examples for manometric liquids. **(04 Marks)**

   c. An inverted U-tube manometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cms. When an oil (S = 0.8) is used as a gauge fluid, the vertical height of the water columns in the two limbs of the inverted manometer (when measured from the respective centre lines of the pipes) are found to be same and equal to 35 cms. Determine the difference of pressure between the pipes. Pipe B is lying below the pipe A. **(08 Marks)**

3 a. Derive an expression for total pressure on one side of an inclined plane and show that the centre of pressure lies lower than its centroid. **(10 Marks)**

   b. A rectangular gate 5m×3m is placed under water such that the 3m edges are parallel to the free surface. The top and bottom edges are 4.0 m and 8.0 m below the water surface respectively. Determine the total pressure and the position of the centre of pressure on the gate. **(10 Marks)**

4 a. What do you mean by equipotential line and line of constant stream function? Show that the stream lines and equipotential lines meet orthogonally. **(08 Marks)**

   b. Write the differences between Lagrangian and Eulerian concepts. **(04 Marks)**

   c. The velocity components in a fluid flow are given by u = 2xy; V = $a^2 + x^2 - y^2$.
   i) Show that the flow is possible
   ii) Obtain an expression for the stream function. **(08 Marks)**

PART – B

5 a. State the Bernoulli's theorem. Starting from Euler's equation of motion along a stream line, derive the Bernoulli's equation. List the assumptions and limitations. **(08 Marks)**

b. 250 liters/sec of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135°, find the magnitude and direction of the force on the bend. The pressure of water flowing is 400 kN/m^2. Take specific weight of water as 9.81 kN/m^3. **(12 Marks)**

6 a. Derive the Darcy-Weisbach equation for head loss due to friction in pipe. **(08 Marks)**

b. Water is to be supplied to the inhabitants of a college campus, through a supply main. The following data is given:
Distance of the reservoir from the campus = 3000 m
Number of inhabitants = 4000
Consumption of water per day of each inhabitants = 180 liters.
Loss of head due to friction = 18 m
Coefficient of friction for the pipe, f = 0.007.
If one half of the daily supply is pumped in 8 hours, determine the size the supply main. **(06 Marks)**

c. A hydraulic pipe line 3 km long, 500 mm diameter is used to convey water with a velocity of 1.5 m/sec. Determine the pressure growth if the valve provided at the out flow end is closed in (i) 20 seconds (ii) 3.5 seconds . Consider pipe to be rigid and take bulk modules of water $K_{water} = 20\times10^8$ N/m^2. **(06 Marks)**

7 a. Briefly explain the following:
i) Point and Hook gauges
ii) Float gauge. **(06 Marks)**

b. With a neat sketch explain the working of a current meter. **(06 Marks)**

c. A pitot static tube is inserted in a 30 cm diameter pipe. The static pressure in the pipe is 12.5 cm of mercury (vacuum). The stagnation pressure at the centre of the pipe is 1.15 N/cm^2 (Gauge). Calculate the rate of flow of water through the pipe. The mean velocity of flow is 0.875 times the central velocity. Take C = 0.985. **(08 Marks)**

8 a. Distinguish between:
i) Venturimeter and orificemeter
ii) Rectangular with inlet and cipolletti notch. **(08 Marks)**

b. A horizontal venturimeter with inlet diameter of 25 cm and throat diameter of 15 cm is used to measure the flow of water. The pressure at the throat is 30 cm of mercury (vacuum) and that at the inlet is 200 kN/m^2(Gauge). Find the discharge of water through the meter. Take $C_d = 0.98$. **(06 Marks)**

c. A jet of water issuing from an orifice 25 mm diameter under a constant head of 1.5 m falls 0.915 m vertically before it strikes the ground at a distance of 2.288 m measured horizontally from the vena contracta. The discharge was found to be 102 ℓpm. Calculate the hydraulic coefficients of the orifice. **(06 Marks)**

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