CBCS SCHEME

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15AU42

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following fluid properties and also mention three units :
i) Density ii) Surface tension iii) Viscosity iv) Specific weight. **(08 Marks)**

b. The dynamic viscosity of on oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. The thickness of oil film is 1.5mm. **(08 Marks)**

OR

2 a. State and prove Pascal's law. **(05 Marks)**

b. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of the fluid in the pipe if the difference of mercury level in the two limbs is 20cm. **(06 Marks)**

c. Determine the total pressure on a circular plate of diameter 1.5m which is placed vertically in water in such a way that the center of the plate is 3m below the free surface of water. Find the position of center of pressure also. **(05 Marks)**

Module-2

3 a. Derive an expression for the meta-centric height of a floating body. **(08 Marks)**

b. A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

OR

4 a. Derive the continuity equation in three dimensional Cartesian coordinates for a steady incompressible flow. **(08 Marks)**

b. Distinguish between :
i) Steady flow and unsteady flow
ii) Uniform and non-uniform flow
iii) Compressible and incompressible flow
iv) Laminar and turbulent flow. **(08 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a steam line for an ideal fluid and hence deduce the Bernoulli's equation of motion. State the assumptions made. **(10 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 4.0m/sec. Find the velocity head at sections 1 and 2 and also rate of discharge. **(06 Marks)**

OR

6 a. Derive an expression for the discharge through venturimeter. **(08 Marks)**

b. Water flows through a triangular right-angled weir first and then over a rectangular well of 1m width. The discharge coefficients of the triangular and rectangular weirs are 0.6 and 0.7 respectively. If the depts of water over the triangular weir is 360mm, find the deptn of water over rectangular weir. **(08 Marks)**

Module-4

7 a. Explain similitude type of similarities. **(06 Marks)**

b. Using Buckingham's π-theorem, show that the velocity though a circular office is given by

$$V = \sqrt{2gH}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

where H is the head causing flow, D is diameter of orifice, μ is coefficient of viscosity, ρ is mass density and g is acceleration due to gravity. **(10 Marks)**

OR

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

b. A horizontal pipe of diameter 500mm is suddenly contracted to a diameter of 250mm. The pressure intersities in the large and smaller pipe is given as 13.734N/cm^2 and 11.772N/cm^2 respectively. Find the loss of heat due to contraction if $C_C = 0.62$. Also determine the rate of flow of water. **(08 Marks)**

Module-5

9 a. Derive an expression for Hagen – Poiscuille's formula. **(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 two ends of pipe, is 100kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. **(06 Marks)**

OR

10 a. Derive an expression for velocity of sound wave in a fluid. **(08 Marks)**

b. Experiments were conducted in a wind–tunnel with a wind speed of 50km/hour on a flat plate of size 2m long and 1m wide. The density of oil is 1.15kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine :

i) Lift force ii) Drag force iii) Resultant force iv) Power exerted by air on plate. **(08 Marks)**

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