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10MEB306/10ME36B/10AU36B/10AUB306

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms with clearly mentioning their units:
i) Weight density ii) Specific gravity iii) Viscosity
iv) Bulk modulus v) Surface tension **(10 Marks)**

b. A steel shaft of 40 mm diameter rotates at 250 r.p.m in a bearing of diameter 42 mm. Lubricant oil of viscosity 5 poise is used for lubrication of shaft in the bearing. Determine the torque required at the shaft and the power lost in maintaining the lubrication length of bearing is 100 mm. **(06 Marks)**

c. A liquid bubble of 2.5 cm radius has an internal pressure of 12.5 Pa. Determine the surface tension of the liquid film. **(04 Marks)**

2 a. Differentiate absolute, gauge, atmospheric and vacuum pressures on a chart. **(06 Marks)**

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

c. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth below the surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(08 Marks)**

3 a. Discuss the conditions of equilibrium of a floating body. **(04 Marks)**

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

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

4 a. Derive Bernoulli's equation for a steady, incompressible fluid flow clearly stating the assumptions. Mention the significance of each term in Bernoulli's equation. **(10 Marks)**

b. A pipeline carrying oil of specific gravity 0.87 changes in diameter from 200 mm at a position A to 500 mm diameter at a position B which is 4m at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s, determine the loss of head and direction of flow? **(10 Marks)**

PART – B

5 a. Derive an expression for discharge through an orifice meter. State its merits and demerits in comparison with venturimeter. **(10 Marks)**

b. The efficiency η of geometrically similar fans depends upon the mass density of air ρ, its viscosity μ, speed of fan N (resolutions per sec.), diameter of blades D and discharge Q. Obtain an expression for efficiency η using Buckingham's π-theorem. **(10 Marks)**

6 a. Derive Darcy-Weisbach equation for loss of head due to friction in pipes and also deduce Chezy's equation. **(12 Marks)**

b. An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres/s. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow. **(08 Marks)**

7 a. Derive an expression for shear stress distribution for laminar flow between two parallel stationary plates. **(10 Marks)**

b. A fluid of viscosity 0.7 NS/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:

i) The pressure gradient
ii) The average velocity
iii) Reynold's number of the flow **(10 Marks)**

8 a. Explain the following:

i) Lift
ii) Boundary layer thickness
iii) Mach number
iv) Mach cone
v) Supersonic flow **(10 Marks)**

b. Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and $u = U$ at $y = \delta$, where δ is boundary layer thickness. **(06 Marks)**

c. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take $R = 287.14$ J/kgK, $K = 1.4$ for air. Assume temperature of air as 15°C. **(04 Marks)**

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