CBCS SCHEME

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21MT34

Third Semester B.E. Degree Examination, June/July 2023
Mechanics of Solids & Fluids

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following :
(i) Poisson's ratio.
(ii) Proof stress.
(iii) Modulus of rigidity. **(06 Marks)**

b. Explain the stress strain curve for mild steel. **(04 Marks)**

c. A brass bar having cross sectional area of 1000 mm^2, is subjected to axial forces shown in Fig. Q1 (c). Find the Elongation of the bar. Take E = 100 GN/m^2.

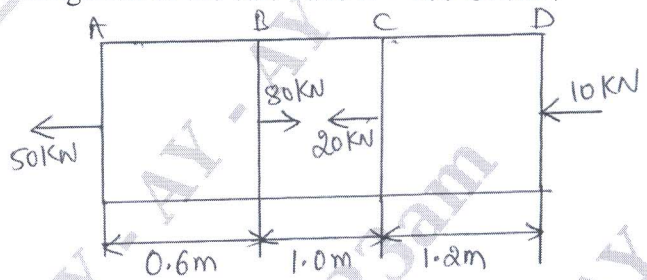

Fig. Q1 (c) **(10 Marks)**

OR

2 a. Derive a relationship between Young's modulus and Modulus of rigidity. **(10 Marks)**

b. A steel rod of cross sectional area 1600 mm^2 and two brass rods. Each of cross sectional area of 1000 mm^2 together support a load of 50 kN as shown in Fig. Q2 (b). Find the stresses in the rods. E for steel = 2×10^5 N/mm^2, E for brass = 1×10^5 N/mm^2.

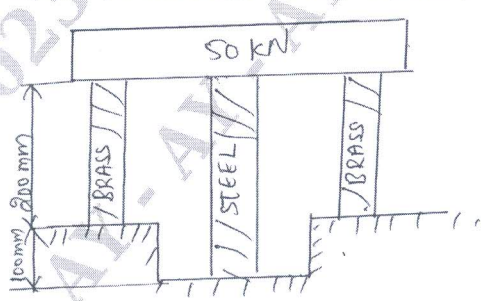

Fig. Q2 (b) **(10 Marks)**

Module-2

3 a. Define the principal stresses and principal planes. **(04 Marks)**

b. Determine the expression for normal and tangential plane θ in a general 2D stress system. **(08 Marks)**

c. Find the Normal, Tangential and Resultant stress on a plane 30° to the plane of principle stress. Find the obliquity of the resultant stress.

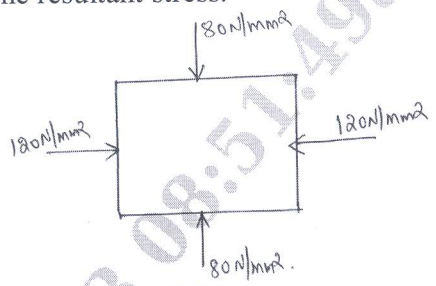

Fig. Q3 (c) **(08 Marks)**

OR

4 The state of stress in two dimensionally stressed body is shown in Fig. Q4. Determine the principal stresses, principal planes, maximum shear stress and their planes. Also draw the Mohr's circle to verify the results obtained analytically. **(20 Marks)**

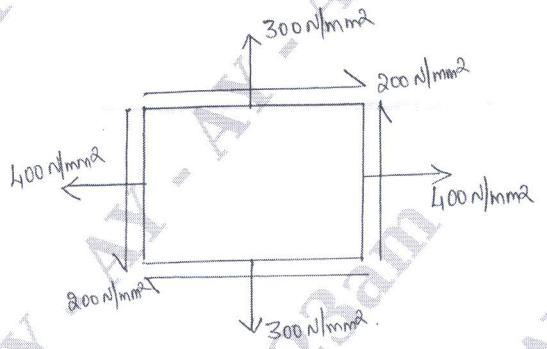

Fig. Q4

Module-3

5 a. With assumptions, derive torsion equation for circular shaft. **(12 Marks)**

b. A Hollow circular shaft of 6 m length and inner and outer diameter of 75 mm and 100 mm is subjected to a torque of 10 kN-m. If G = 80 GPa. Determine maximum shear stress produced and the total angle of twist. **(08 Marks)**

OR

6 a. Derive Euler's theory for axially loaded long column, when the one end of column is Fixed and other end is pinned. **(08 Marks)**

b. Write the assumption in Euler's column theory. **(04 Marks)**

c. A hollow circular section 2.8 m long column is fixed at one end and hinged at the other end. External diameter is 150 mm and thickness of wall is 15 mm. Ranking constant = $\frac{1}{1600}$ and $\sigma_c = 550$ MPa. Compare the buckling loads obtained by using Euler's formula and Rankine formula. Also find the length of column for which both formulae gives the salve load. Take E = 80 GPa. **(08 Marks)**

Module-4

7 a. Define the following :

(i) Mass density (ii) Specific weight (iii) Specific gravity

(iv) Viscosity (v) Newton's law of viscosity. **(10 Marks)**

b. The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 metre per sec requires a force of 98.1 N to maintain the speed. Determine
(i) The dynamic viscosity of the oil in poise.
(ii) The kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95. **(10 Marks)**

OR

8 a. Derive an expression for total pressure and centre of pressure for a vertical plane submerged in liquid. **(10 Marks)**

b. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4 m when it is immersed vertically in an oil of sp.gr. 0.9. The base of the plate coincides with the free surface of oil. **(10 Marks)**

Module-5

9 a. Briefly explain the types of fluid flow. **(10 Marks)**

b. Derive continuity equation in Cartesian coordinates in three dimensions. **(10 Marks)**

OR

10 a. With assumptions derive Euler's equation of motion. **(10 Marks)**

b. A non-uniform part of a pipe line 5 m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameters at the upper and lower ends are 15 cm and 10 cm respectively, determine the quantity of water flowing per second. **(10 Marks)**

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