CBCS SCHEME

USN

17ME/MA34

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. State the Hooke's Law. Neatly draw the stress – strain diagram for steel indicating all salient points and zones on it. **(05 Marks)**

b. Derive an expression for the extension of uniformly tapering circular bar subjected to axial load. **(05 Marks)**

c. A steel bar ABCD of varying sections is subjected to the axial forces as shown in fig.Q1(c). Find the value of P necessary for equilibrium. If E = 210 kN/mm^2, determine

i) Stress in various segments ii) Total elongation of bar. **(10 Marks)**

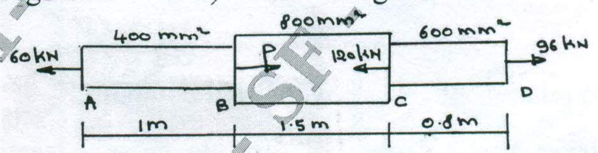

Fig.Q1(c)

OR

2 a. A compound bar is made up of a central aluminium plate 24mm wide and 6mm thick to which steel plates of 24mm wide and 9mm thick are connected rigidly on each side. The length of compound bar at temperature 20^{0}C is 100mm. If the temperature of the whole assembly is raised by 60^{0}C, determine the stress in each of the material. If at the new temperature a compressive load of 20kN is applied to the composite bar. What are the final stresses in steel and aluminum?

Given $E_S = 2 \times 10^5$ N/mm^2, $E_A = \frac{2}{3} \times 10^5$ N/mm^2, **(12 Marks)**

$\alpha_S = 12 \times 10^{-6} / {}^0C$ and $\alpha_A = 23 \times 10^{-6} / {}^0C$.

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(08 Marks)**

Module-2

3 a. Define i) Principal stress ii) Principal strain. **(04 Marks)**

b. At a certain point in a strained material the stress condition shown in fig. Q3(b) exists. Find

i) Normal and shear stress on the inclined plane AB.

ii) Principal stresses and principal planes.

iii) Maximum shear stresses and their planes. **(16 Marks)**

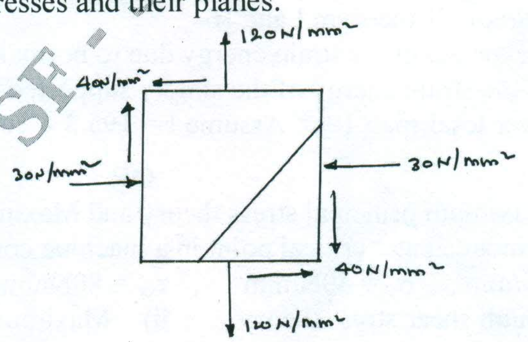

Fig.Q3(b)

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OR

4 a. Derive an expression for circumferential stress and longitudinal stress for a thin cylinder subjected to an internal pressure. **(08 Marks)**

b. List the difference between thin and thick cylinders. **(02 Marks)**

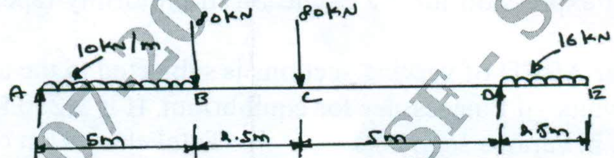
c. A thick cylinder pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure 20N/mm^2 and external fluid pressure of 5N/mm^2. Determine the maximum hoop stress developed. Draw the variation of hoop stress and radial stress across the thickness indicating the values at every 25mm interval. **(10 Marks)**

Module-3

5 a. What are different types of beams? Explain briefly. **(05 Marks)**

b. Draw shear force and bending moment diagrams for the beam shown in fig. Q5(b). Locate point of contra flexure if any. **(15 Marks)**

Fig.Q5(b)



OR

6 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. A cantilever has a length of 3m. Its cross – section is of T – section with flange 100mm × 20mm and web 200mm × 12mm, the flange is in tension. What is the intensity of UDL that can be applied if the maximum tensile stress is limited to 30N/mm^2? Also compute the maximum compressive stress. **(10 Marks)**

Module-4

7 a. What are the assumption made in theory of pure torsion? **(02 Marks)**

b. Derive torsion equation with usual notations. **(08 Marks)**

c. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm. Find the diameter of the shatt, if the shear stress of the material must not exceed 80N/mm^2. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained if the shatt is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length , material and maximum shear stress being same. **(10 Marks)**

OR

8 a. Derive an expression for the critical load in a column subjected to compressive load, when both the ends are hinged. Also mention the assumptions made in the derivation. **(10 Marks)**

b. Design the section of a circular cast iron column that can safety carry a load of 1000kN. The length of the column is 6 meters. Rankine's constant is 1/1000 , factor of safety is 3. One end of the column is fixed and other end is free. Critical stress is 560 MPa. **(10 Marks)**

Module-5

9 a. State Castiglione's theorem I and II. **(04 Marks)**

b. Derive an expression for strain energy due to normal stress. **(08 Marks)**

c. Determine the strain energy of the simply supported prismatic beam , subjected to UDL of 25kN/m over total span 10m. Assume I = 195.3 × 10^3 mm^4 , E = 2 × 10^5 MPa. **(08 Marks)**

OR

10 a. Explain Maximum principal stress theory and Maximum shear stress theory. **(10 Marks)**

b. The stress induced at a critical point in a machine component made of steel are as follows : σ_x = 100N/mm^2 , σ_y = 40N/mm^2 , τ_{xy} = 80N/mm^2. Calculate the factor of safety by
i) Maximum shear stress theory ii) Maximum normal stress theory. **(10 Marks)**