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10CV/EV33

Third Semester B.E. Degree Examination, Dec.2017/Jan.2018

Strength of Materials

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: (i) Yielding, (ii) Hooke's law. **(04 Marks)**

b. Derive an expression for the deformation of tapering plate of uniform thickness subjected to axial force F. **(06 Marks)**

c. A brass tube 100 mm internal diameter and 10 mm thick is enclosed in a steel tube 120 mm internal diameter and 10 mm. Both the tubes are rigidly fixed to each other and carries an axial load of 3000 kN. The tubes are of same length of 3m. Determine the load carried, stress induced in each material. Also determine the amount by which it shortens. Given $E_S = 200$ kN/mm^2, $E_B = 100$ kN/mm^2. **(10 Marks)**

2 a. Define: (i) Lateral strain, (ii) Bulk modulus. **(04 Marks)**

b. Derive the relationship between Young's modulus and shear modulus. **(06 Marks)**

c. A steel bar 25 mm in diameter is enclosed in a brass tube 25 mm internal diameter and 50 mm external diameter. Both the bars are of length 1m and rigidly fixed to each other. The composite bar is subjected to rise in temperature of 60°C. Determine the stresses due to temperature change.

If in addition to temperature change the bar is subjected to a pull of 60 kN, determine resultant stresses $E_B = 100$ kN/mm^2, $E_s = 200$ kN/mm^2, $\alpha_s = 12 \times 10^{-6}$/°C, $\alpha_B = 18 \times 10^{-6}$/°C. **(10 Marks)**

3 a. Define:

i) Principal stresses,
ii) Critical planes,
iii) Principal planes. **(06 Marks)**

b. The stresses on a strained element are as shown in Fig.Q3(b). Determine:

i) Stresses when the element is rotated through an angle of 30° as shown.
ii) Principal plane and principal stresses.

Sketch the planes.

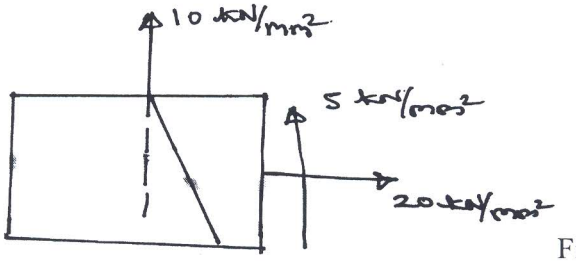

Fig.Q3(b) **(14 Marks)**

4 a. Define:

i) Hogging bending moment
ii) Sagging bending moment
iii) Point of contraflexure. **(06 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q4(b) showing salient features.

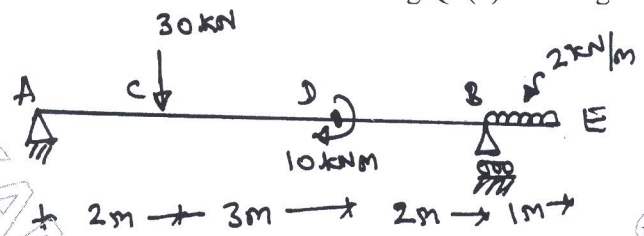

Fig.Q4(b) **(14 Marks)**

PART – B

5 a. Prove that maximum shear stress in a rectangular section of width b and depth d is equal to 1.5 times of its average shear stress. **(05 Marks)**

b. State the assumptions made in the theory of pure bending. **(05 Marks)**

c. A rolled I section of size 75 mm × 50 mm is used as a beam with an effective span of 3m. The flanges are 5 mm thick and web 3.7 mm thick. Calculate the uniformly distributed load the beam can carry if the maximum shear stress is 40 N/mm^2. **(10 Marks)**

6 a. Derive an expression for slope at support and maximum deflection for a simply supported beam subjected to point load at midspan. **(08 Marks)**

b. Distinguish between nature of slope and deflection of a simply supported beam and a cantilever beam. **(04 Marks)**

c. A cantilever beam of uniform cross section carries UDL of 30 kN/m over entire span of 3m. Given I = 5 × 10^8 mm^4 and deflection at free end 3.04 mm, determine Young's modulus of elasticity of beam material. **(08 Marks)**

7 a. Prove that a hollow shaft is stronger and stiffer than the solid shaft of same material, length and weight. **(08 Marks)**

b. Determine the diameter of the solid shaft transmitting 120 kW at 120 rpm if the permissible shear stress is 80 N/mm^2. What would be the diameter of a hollow shaft of same length having external diameter twice the internal diameter to transmit same power at same rate of revolution. What is the percentage saving in weight by changing over to hollow shaft? **(12 Marks)**

8 a. State the assumptions made in Euler's theory for long columns. Also state limitations of Euler's formula. **(06 Marks)**

b. Derive an expression for Euler's buckling load with both ends hinged. **(06 Marks)**

c. Calculate the safe compressive load on a hollow cast iron column one end rigidly fixed and other end hinged of 150 mm external diameter and 110 mm internal diameter. The column is 10m in length. Use Euler's formula with a factor of safety of 5 and E = 100 kN/mm^2. **(08 Marks)**

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