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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Mechanical Engineering

Semester End Examination; May / June - 2018

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define the following :

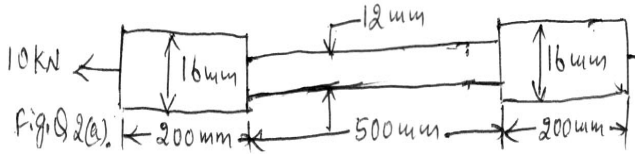
(i) Linear strain (ii) Lateral strain (iii) Poisson's ratio (iv) Nominal (engineering) stress (v) True stress (vi) Factor of safety — 12

b. A specimen of steel 25 mm diameter, with a gauge length of 200 mm is tested to destruction. It has an extension of 0.16 mm under a load of 80 kN and the maximum load is 180° kN. The total extension at fracture is 56 mm and diameter at neck is 18 mm, find; — 8

(i) Young's modulus (ii) Percentage elongation

(iii) Percentage reduction in area (iv) Ultimate tensile stress

2 a. The bar with circular cross-section as shown in Fig.Q.2(a). is subjected to a load of 10 kN. Determine the strain energy stored in it. Take E = 2.1×10^5 N/mm^2. — 8



b. An axial blow applied to bar A shown in Fig.Q.2(b) produced an instantaneous extension of 0.25 mm. What will be the instantaneous maximum stress and extension in bar B, if the same blow is applied axially? The bars are having circular cross-section. — 12

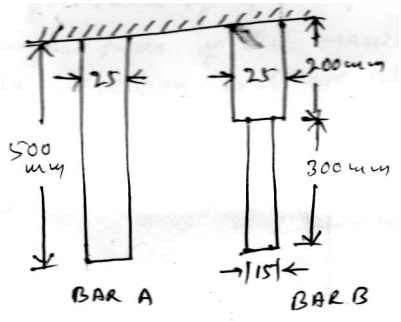


Fig. Q.2(b)

UNIT - II

3 a. Write down the expression for change in length due to change in temperature and name each term. — 2

b. Define coefficient of thermal expansion. — 2

Contd…2

c. A horizontal rigid bar AB weighing 200 kN is hung by three vertical rods, each of 1 m length and 500 mm^2 in cross section as shown in Fig.Q.3(c). The central rod is of steel and the other rods are copper. If the temperature rise is 40°C, estimate load carried by each rod and by how much the load will descend. Take E_s = 200 GN/m^2, E_c = 100 GN/m^2, $\alpha_s = 1.2\times10^{-5}$/°C, $\alpha_C = 1.8\times10^{-5}$/°C. What should be the temperature rise, if the entire load of 200 kN is to be carried by steel rod alone? 16

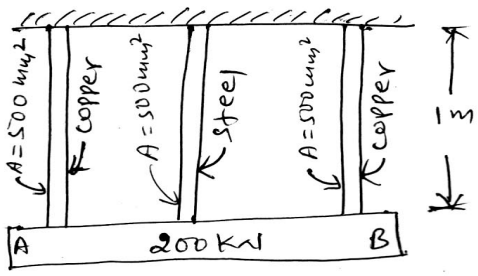


Fig.Q.3(c)

4. The state of stress at a point in a strained material is as shown in Fig.Q.4. Determine;

(i) The direction of the principal planes (ii) The magnitude of principal stresses

(iii) The magnitude of the maximum shear stress and its direction. Indicate all the above planes by a sketch

(iv) Draw Mohr's circle and verify the results obtained analytically. 20

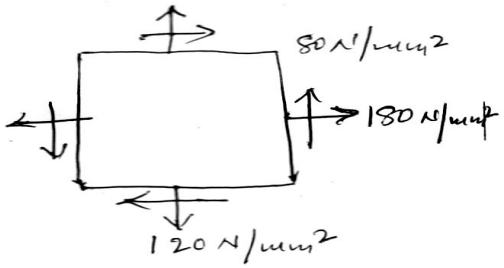


Fig.Q.4

UNIT - III

5 a. Define: (i) Shear force (ii) Bending moment. 4

b. Draw space diagrams for the following:

(i) Cantilever beam subjected to uniformly distributed load

(ii) Simply supported beam subjected to uniformly varying load. 4

Also draw representative shear force diagram for both the cases.

c. A simply supported beam AB of 6 m span is loaded as shown in Fig.Q.5(c). Draw the shear force and bending moment diagrams. 12

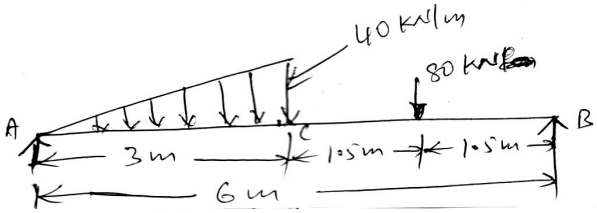


Fig.Q.5(c)

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6. Draw the bending moment and shear force diagrams for the beam shown in Fig.Q.6. Indicate the salient values on the diagrams. 20

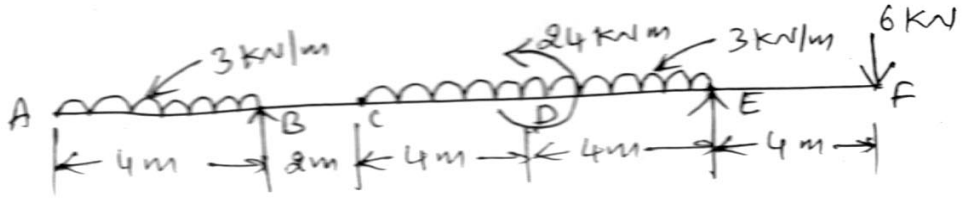

Fig.Q.6

UNIT - IV

7 a. List the assumptions made in simple theory of bending. 5

b. A cast iron beam has an I-section with top flange 80 mm×40 mm, web 120 mm×20 mm and bottom flange 160 mm×40 mm. If tensile stress is not to exceed 30 N/mm^2 and compressive stress 90 N/mm^2, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6m if the larger flange is in tension? Take I = 60138670 mm^4. 15

8 a. Explain double integration method used in calculating deflections of beams. 4

b. A beam AB is 6 m long and has a moment of inertia of 450×10^6 mm^4. It is supported at A and B and carries a uniformly distributed load of 10 kN/m from C to D as shown in Fig.Q.8(b). Calculate the (i) slope at A (ii) Deflection at mid-span (iii) maximum deflection. Take E = 200 kN/mm^2. 16

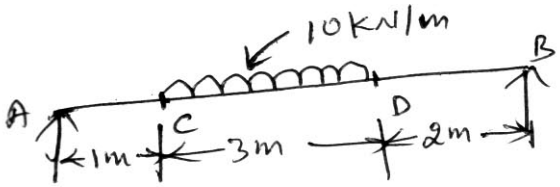

Fig.Q.8(b)

UNIT - V

9 a. Enumerate the assumptions made in the theory of pure torsion. 5

b. Compare the weight of solid shaft with that of a hollow one having the same length to transmit a given power at a given speed. If the material used for both the shaft is the same. Take the inside diameter of the hollow shaft as 0.6 times and the outer diameter. Compare (i) from the consideration of maximum shear stress (ii) from the consideration of maximum angle of twist. 15

10 a. Explain limitations of Euler's theory. 5

b. Obtain an expression for Euler's buckling load for a column whose one end is fixed and the other end hinged. 10

c. Calculate the critical load of a strut which is made of a bar, circular in section and 5 m long and which is pin jointed at both ends. The same bar when used as a simply supported beam gives a mid-span deflection of 10 mm with a load of 10 N at the centre. 5

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