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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec. - 2015

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions selecting **ONE** full question from each **unit**.*
ii) Assume suitable missing data if any.

UNIT - I

1 a. Derive an expression for the deformation of a rectangular tapering bar subjected to direct load. 10

b. A steel bar of 25 mm diameter is acted upon by forces as shown in Fig. Q 1 (b). Determine the total elongation of bar with E = 200 kN/mm^2. 10

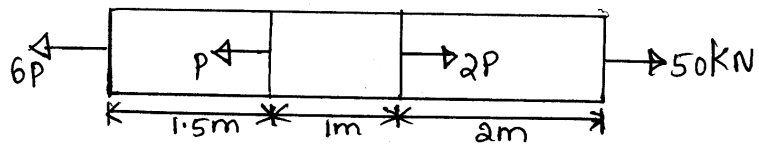

fig Q(1b)

2 a. Derive an expression for the relationship between modulus of elasticity and modulus of rigidity. 10

b. A 500 mm long bar has rectangular cross – section 20 mm x 40 mm. This bar is subjected to various loads as shown in Fig. Q 2 (b). Find the change in volume if E = 2x10^5 N/mm^2 and μ = 0.3. 10

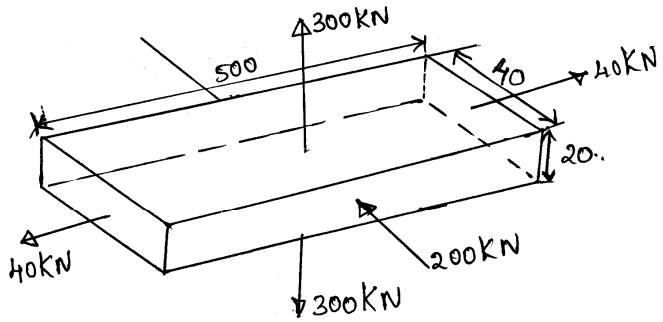

fig Q(2b)

UNIT - II

3 a. Three pillars, two of aluminium and one of steel support a rigid platform of 20 kN as shown in Fig. Q 3 (a). If area of each aluminium pillar is 1000 mm^2 and that of steel pillar is 800 mm^2, find the stress developed in each pillar. Take; E_a = 1x10^5 N/mm^2 and E_s = 2x10^5 N/mm^2. What additional load P can it take if working stresses are 65 N/mm^2 in aluminium and 150N/mm^2 in steel? 12

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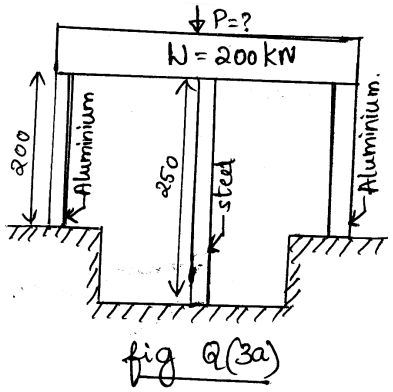

fig Q(3a)

b. A composite bar is rigidly fitted at the support A and B as shown in Fig. Q 3 (b). Determine the reactions at the supports when temperature rises by 20ºC. Take; E_a = 70 GN/m^2, E_s = 200 GN/m^2, α_a = 11 x 10^{-6}/ºC and α_s = 12 x 10^{-6}/ºC. 8

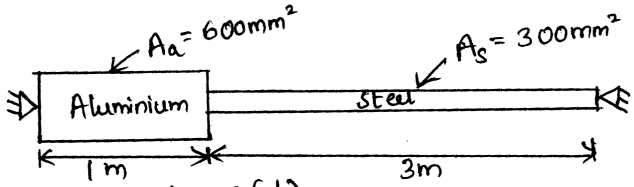

fig Q(3b)

4 a. The direct stresses acting at a point in a strained material case as shown in Fig. Q 4 (a). Find the normal, tangential and the resultant stresses on a plane 30º to the plane of major principle stress. Find the obliquity of the resultant stress. Find the obliquity of the resultant stress also. 8

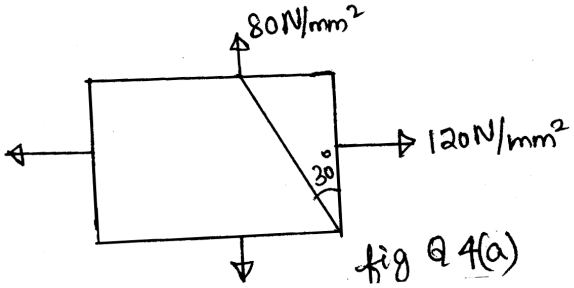

fig Q 4(a)

b. The state of stress at a point in a strained material is as shown in Fig. Q 4 (b). Draw Mohr's circle and verify the results obtained analytically by determining the magnitude and directions of principal stresses and also maximum shear strain. 12

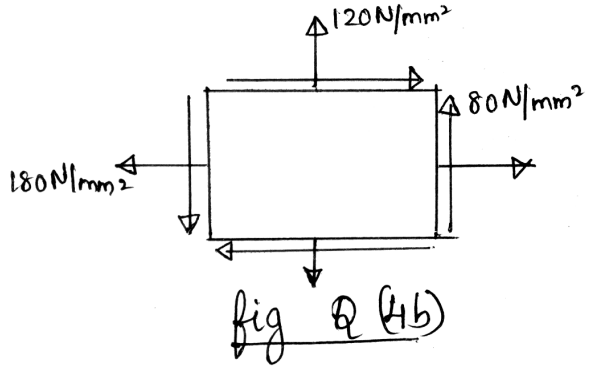

fig Q (4b)

Contd…3

UNIT - III

5 a. Drive expression for longitudinal stress and hoop stress of a thin cylinder subjected to fluid pressure. 8

b. A thick cylinder of external and internal diameters of 300 mm and 180 mm is subjected to an internal pressure of 42 N/mm^2 and external pressure 6 N/mm^2. Determine the stresses in the material. Now if the external pressure is doubled, what internal pressure can be maintained without exceeding the previously determined maximum stress? 12

6. a. Draw shear force diagram and bending moment diagram for simply supported beam subjected to concentrated load and uniformly distributed load 'W' N/m of length 'L'. 10

b. A simply supported beam AB of 8 m span is loaded as shown in Fig. Q 6 (b) carries two concentrated loads and a uniformly distributed load. Draw shear force diagram and bending moment diagram. 10

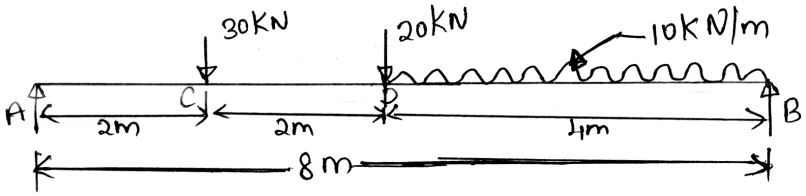

fig Q(6b)

UNIT - IV

7. Derive an expression for;

i) Relationship between bending stress and radius of curvature. 20

ii) Relationship between moment and radius of curvature.

8 a. State any 5 assumptions made in simple theory of bending. 5

b. The cross – section of a beam is as shown in Fig. Q 8 (b). If permissible stress is 150 N/mm^2, Find its moment of resistance. Compare it with equivalent section of same area but,

i) Square section

ii) Rectangular section with depth twice the width

iii) A circular section. 15

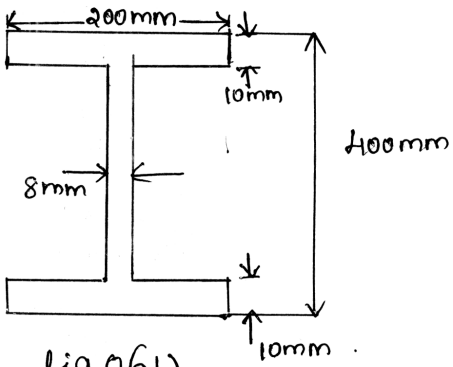

fig Q(8b)

Contd…4

UNIT - V

9 a. Derive an expression for differential equation for deflection. 10

b. A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from left support as shown in Fig. Q 9 (b). Calculate. 10

i) The position and the value of maximum deflection.

ii) Slope at mid span.

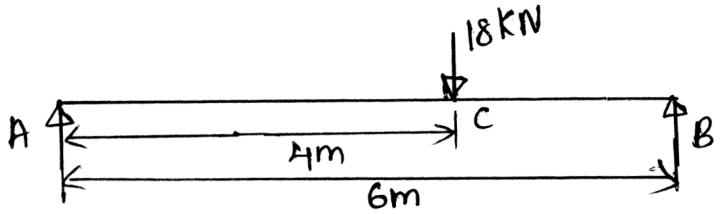

fig Q(9b)

10 a. A hollow circular shaft 200 mm external diameters and thickness of metal 25 mm is transmitting power at 200 rpm. The angle of twist over a length was found to be 0.5 degree. Calculate the power transmitted and the maximum shear stress induced in the section. Take modulus of rigidity of material as 84 kN/mm^2. 8

b. Prove that a hollow shaft is stronger than the solid shaft of the same material, length and weight. 5

c. Determine the buckling load for a strut of tee section, the flange width being 100 mm, overall depth 80 mm and both flange and stem 10mm thick as shown in Fig. Q10 (c). The struck is 3m long and is hinged at both ends. Take; E = 200 GN/m^2. 7

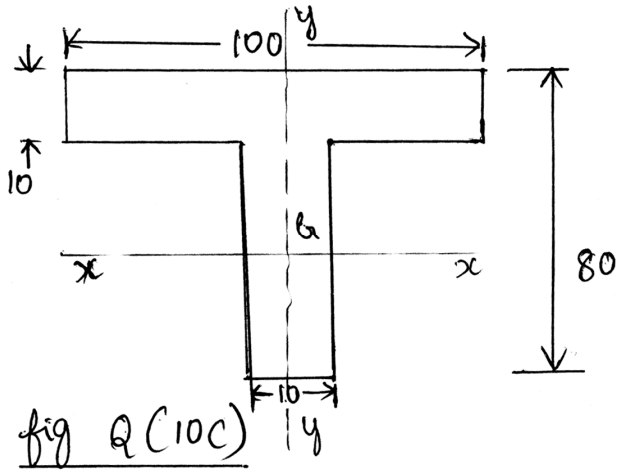

fig Q(10c)

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