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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Mechanics of Materials

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1 a. Draw the stress strain diagrams for mild steel, aluminum and cast iron. Show the salient points on stress-strain diagram for mild steel and explain each one of them. 10

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 load at elastic limit is 160 kN. The maximum load is 180 kN. The total extension at fracture is 56 mm and diameter at neck is 18 mm. Find; 10

i) The stress at elastic limit ii) Young's modulus iii) Percentage elongation

iv) Percentage reduction in area v) Ultimate tensile stress

2 a. A 1.5 m long steel bar is having uniform diameter of 40 mm for a length of 1 m and in the next 0.5 m its diameter gradually reduces from 40 mm to 20 mm. Determine the elongation of this bar when subjected to an axial tensile load of 160 kN. Take E = 200 GPa. 10

b. Obtain the relationship between modulus of elasticity and bulk modulus. 10

UNIT - II

3 a. A compound bar consists of a circular rod of steel of diameter 20 mm rigidly fitted into a copper tube of internal diameter 20 mm and thickness 5 mm. If the bar is subjected to a load of 100 kN, find the stresses developed in the two materials. 10

Take $E_S = 2x10^5$ and $E_C = 1.2 \times 10^5$ N/mm^2.

b. A bar of brass 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The bar and the tube are both initially 1.5 m long and are rigidly fastened at both ends using 20 mm diameter pins. Find the stresses in the two materials when the temperature rises from 30ºC to 100ºC. Take E_S = 200 m, E_b = 100 kN/mm^2, $\alpha_s = 11.6x10^{-6}$/ºC and $\alpha_b = 18.7x10^{-6}$/ºC. Find also shear stress induced in the pins. 10

4. The state of stress at a point in a strained material is shown in Fig. Q4. Determine;

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

iii) The magnitude of maximum shear stress. 20

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Indicate all the above planes by a sketch. Draw Mohr's circle and verify the results obtained graphically with the analytical results.

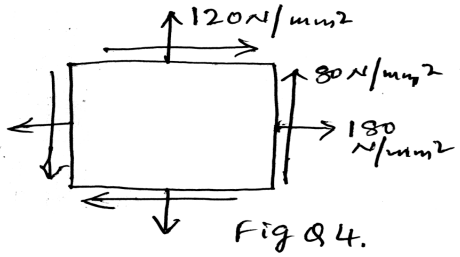


Fig Q4.

UNIT - III

5. Draw shear force and bending moment diagram for the beam shown in Fig. Q5. 20

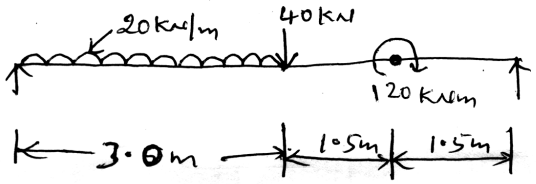


Fig Q5

6. Draw the SF and BM diagrams for the beam shown in Fig. Q6. Find the point of contraflexure and maximum bending moment. 20

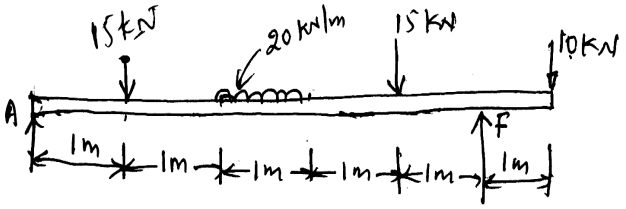


Fig Q6

UNIT - IV

7 a. State atleast five assumptions in simple theory of bending. 5

b. The Cross-section of a beam is as shown in Fig. Q7b. If permissible stress is 150 N/mm^2, find its moment of resistance, compare it with equivalent section of same area but, 15

i) Square section ii) Rectangular section with depth twice the width iii) A circular section.

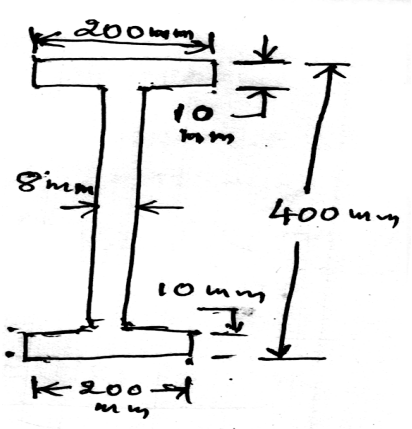


Fig. Q7b.

Contd….3

8 a. Find the displacement at free end of the cantilever shown in Fig. 8a. Find its numerical value of L = 3 m, a = 2 m, W_1 = 20 kN, W_2 = 30 kN, E = $2x10^5$ N/mm^2, I = $2x10^8$ mm^4. 10

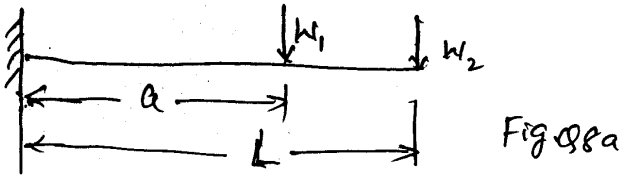


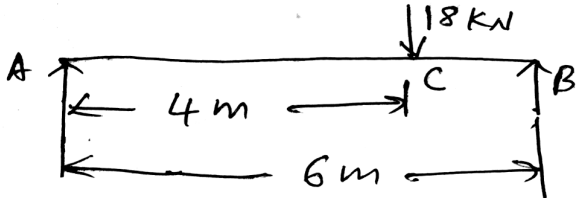
Fig Q8a

b. A simply supported beam of 6 m span is subjected to a concentrated load of 18 kN at 4 m from left support. Calculate;

i) The position and the value of maximum deflection

ii) Scope at mid-span

iii) Deflection at the load point Use Macaulay's method. 10



UNIT - V

9. A cylindrical shell is 3 m long and is having 1 m internal diameter and 15 mm thickness. Calculate the maximum intensity of shear stress induced and also the changes in the dimensions of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm^2. 20

10a.. Derive $\frac{T}{J} = \frac{q}{r} = \frac{G\theta}{L}$ with assumptions. 10

b. A 2 m long pin ended column of square cross-section is to be made of wood. Assuming E = 12 GPa and allowable stress being limited to 12 MPa, determine the size of the column to support 95 kN safely. Use factor of safety 3 and Euler's crippling load for buckling. 10

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