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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 - 2016/Jan - 2017

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. The tensile test was conducted on a mild steel bar. The following data was obtained from the test.

Diameter of steel bar = 16 mm, Gauge length of the bar = 80 mm, Load at proportionality limit = 72 kN, Extension at a load of 60 kN = 0.115 mm, Load at failure = 80 kN. Final gauge lengths of bar = 104 mm. Diameter of the rod at failure = 12 mm. Determine; 12

i) Young's modulus ii) Proportionality limit

iii) True breaking stress iv) Percentage elongation.

b. Derive the equation for total extension of a tapering bar of circular cross section. 8

2 a. A settle bar ABCD of varying sections is subjected to the axial forces as shown in Fig. Q2(a). Find the value of 'P' necessary for equilibrium. If E = 210 kN/mm^2. Determine;

i) Stress in various segments ii) Total elongation of the bar iii) Total strain in the bar. 12

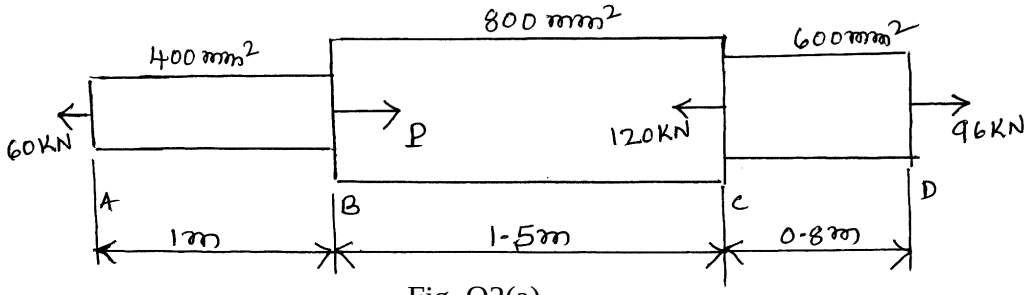

Fig. Q2(a).

b. Determine the changes in length, width and thickness of a steel bar which is 4 meters long, 30 mm wide and 20 mm thick and is subjected to an axial pull of 30 kN in the direction of length. E = 2x10^5 N/mm^2 and Poisson's ratio = 0.3. Also determine the volumetric strain, change in volume and final volume of the given bar. 8

UNIT - II

3 a. A steel tube of 25 mm external diameter and 18 mm internal diameter encloses a copper rod of 15 mm diameter. The ends are rigidly fastened to each other. Calculate the stress in the rod and the tube when the temperature is raised from 15ºC to 200ºC. 12

Take α_{steel} = 11x10^{-6}/ºC, α_{copper} = 18x10^{-6}/ºC, E_{steel} = 200 GPa and E_{copper} = 100 GPa.

Contd.....2

b. A point in a strained material is subjected to a tensile stress of 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliquity on a plane making an angle of 30^o with the axis of the second stress, also find the maximum shear stress. 8

4 a. Derive an equation for normal stress on a plane inclined at an angle θ is subjected to two perpendicular normal stresses accompanied with a state of simple shear. 8

b. A point in a strained material is subjected to stress as shown in Fig. Q 4(b). Find using Mohr's circle method the normal, tangential and resultant stress across the plane EF. Also determine the maximum, minimum principal stresses, its locations. 12

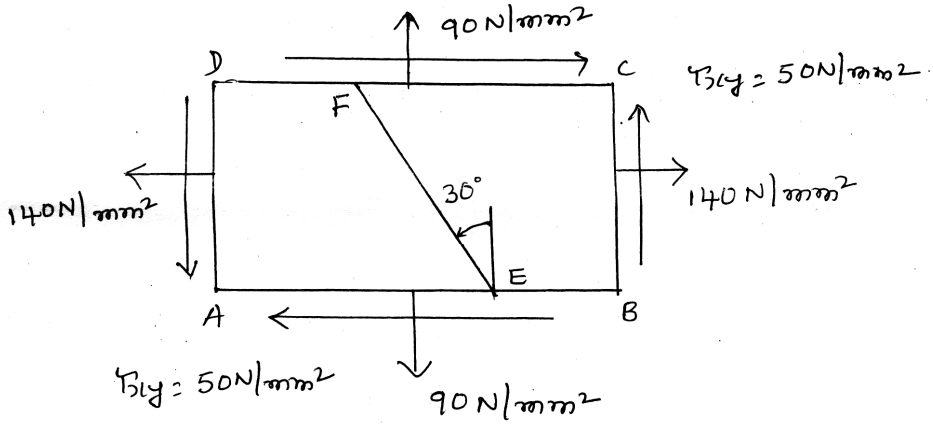

Fig Q 4(b)

UNIT - III

5 a. A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external fluid pressure of 5 N/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 25 mm interval. 12

b. With neat sketches, explain different types of beams, supports and loads. 8

6 a. Draw the shear force and bending moment diagram for the beam shown in Fig. Q 6(a) locate the point of contra flexure if any. 12

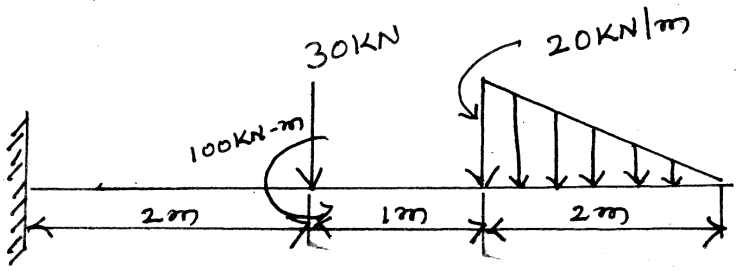

Fig Q 6(a)

b. Derive the relationship between load, shear force and bending moment. 8

Contd.....3

UNIT - IV

7 a. Compare the flexure strength of the following three beams of equal weight.
Same material and same lengths.
i) I-section 200 mm x 300 mm having 10 mm flange thickness and 10 mm web thickness
ii) Rectangular section having depth equal to twice the width
iii) Solid circular section. 12

b. A cast Iron bracket of I-section with equal flanges of 100 mm x 200 mm having 10 mm flange thickness and 5 mm web thickness carries as UDL of 10 kN/m. On a span of 10 meters length determine the position of neutral axis, MI about the neutral axis and the maximum stress distribution. 8

8 a. Draw the shear stress distribution for;
i) I-section ii) T-section. 8

b. A beam of 'T' section has flanges 100 mm x 20mm and web 200 mm x 12 mm is subjected to a vertical shear force of 200 kN. Find the shear stress at the flange, junction, and neutral axis. Also sketch the stress distribution diagram. 12

UNIT - V

9 a. A cantilever beam of 2 meters long is carrying a load of 20 kN at its free end and 30 kN at a distance of 1 meter from the free end. Find the slope and deflection at the free end take $I = 15x10^7\ mm^4$. $E = 2x10^5\ N/mm^2$. 12

b. Derive an equation for maximum deflection of a simply supported beam with 9 point load at center. 8

10 a. A solid shaft is subjected to a maximum torque of 25 kN-m. Find a suitable diameter of a solid shaft. If the allowable shear stress and the twist are limited to 80 N/mm^2 and 1^o respectively for a length of 20 times the diameter of the shaft. 8

b. What are columns and types of columns? Explain. 4

c. Explain the following :
i) Slenderness ratio
ii) Radius of gyration
iii) Most commonly used end conditions for the analysis of columns. 8

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