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10ME/AU/PM/TL34

Third Semester B.E. Degree Examination, June/July 2013
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data may be suitably assumed wherever necessary.

PART – A

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

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

Determine: i) Young's modulus; ii) Proportionality limit; iii) True breaking stress and iv) Percentage elongation. **(10 Marks)**

b. A brass bar having cross-sectional area 300mm^2 is subjected to axial forces as shown in Fig.Q.1(b). Find the total elongation of the bar. E = 84 GPa. **(10 Marks)**

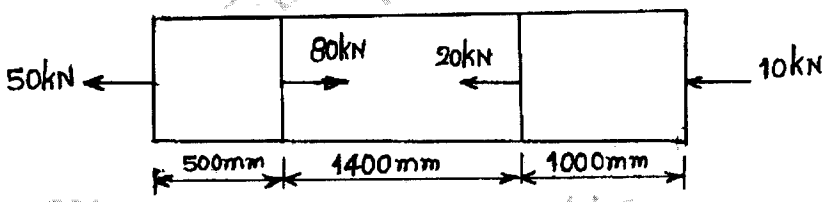

Fig.Q.1(b)

2 a. A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G, K. **(08 Marks)**

b. A composite bar made up of aluminium and steel is held between two supports as shown in Fig.Q.2(b). The bars are stress free at a temperature of 42°C. What will be the stresses in the two bars with the temperature drops to 24°C. If i) The supports are unyielding; ii) the supports come nearer to each other by 0.1mm. The cross-sectional area of steel bar is 160mm^2 and that of aluminium bar is 240mm^2, $E_A = 0.7 \times 10^5$ MPa, $E_S = 2 \times 10^5$ MPa, $\alpha_A = 24 \times 10^{-6}$ per °C and $\alpha_S = 12 \times 10^{-6}$ per °C. **(12 Marks)**

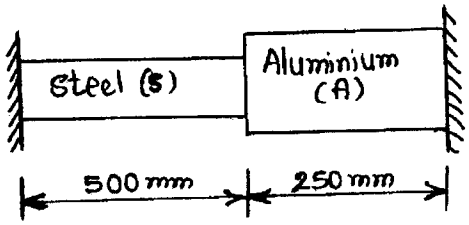

Fig.Q.2(b)

3 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(08 Marks)**

b. At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80MPa and 32MPa, both tensile and there is a shear stress of 32MPa clock wise on the plane carrying 80MPa stresses across the planes as shown in Fig.Q.3(b). Determine:

i) Maximum and minimum normal stresses and locate their planes.

ii) Maximum shear stress and specify its plane. **(12 Marks)**

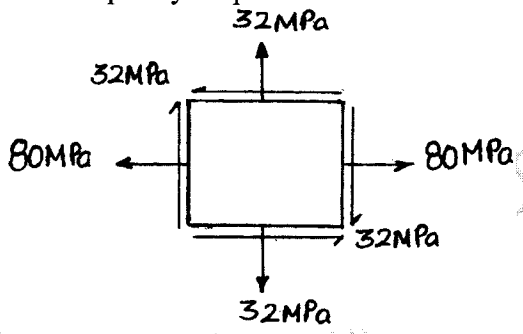

Fig.Q.3(b)

4 a. State Castigliano's theorem. Where do you use it? **(03 Marks)**

b. The bar with circular cross-section as shown in Fig.Q.4(b) is subjected to a load of 10kN. Determine the strain energy stored in it. Take $E = 2.1 \times 10^5$ N/mm^2. **(07 Marks)**

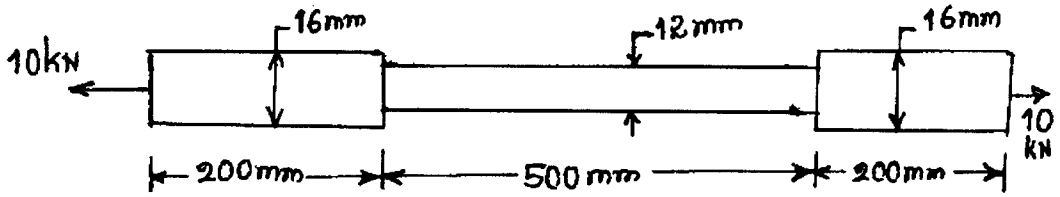

Fig.Q.4(b)

c. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3MPa. Determine the change in length, diameter and volume. Also find the maximum shearing stress in the shell. Assume Poison's ratio is 0.3 and E = 210GPa. **(10 Marks)**

PART – B

5 a. Explain the terms:

i) Sagging bending moment.

ii) Hogging bending moment.

iii) Point of contraflexure. **(06 Marks)**

b. What are the different types of loads acting on a beam? Explain with sketches. **(06 Marks)**

c. A simply supported beam of span 6m is subjected to a concentrated load of 25kN acting at a distance of 2m from the left end. Also subjected to an uniformly distributed load of 10kN/m over the entire span. Draw the bending moment and shear force diagrams indicating the maximum and minimum values. **(08 Marks)**

6 a. Enumerate the assumptions made in the theory of simple bending. **(04 Marks)**

b. A cantilever of square section 200mm × 200mm, 2m long, just fails in flexure when a load of 12kN is placed at is free end. A beam of the same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(08 Marks)**

c. A rolled I section of size 50mm × 75mm is used as a beam, with an effective span of 3 meters. The flanges are 5mm thick and web is 3.75mm thick. Calculate the uniformly distributed load the beam can carry if the maximum intensity of shear stress induced is limited to 40N/mm^2. **(08 Marks)**

7 a. Show that for a simply supported beam of length 'l' carrying a concentrated load W at its mid span, the maximum deflection in Wl^3/48EI. **(10 Marks)**

b. A simply supported steel beam having uniform cross-section is 14m span and is simply supported at its ends. It carries a concentrated load of 120kN and 80kN at two points 3m and 4.5m from the left and right end respectively. If the moment of inertia of the section is 160×10^7 mm^4 and E = 210 GPa, calculate the deflection of the beam at load points. **(10 Marks)**

8 a. A hollow circular steel shaft has to transmit 60kW at 210 rpm such that the maximum shear stress does not exceed 60MPa. If the ratio of internal to external diameter is equal to ¾ and the value of rigidity modulus is 84 GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(10 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate the safe load using.

Rankine's formula taking yield stress 560N/mm^2 and $\alpha = \frac{1}{1600}$.

Euler's formula, taking E = 1.2×10^5 N/mm^2. **(10 Marks)**

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