CBCS SCHEME

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18MT33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data may suitably be assumed.

Module-1

1 a. Define the following:
i) Hook's Law
ii) Poisson's ratio
iii) Young's Modulus
iv) Principle of Super Position. **(04 Marks)**

b. Derive an Expression for deformation of Uniformly Tapering Circular bar. **(08 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in Fig.Q.1(c). Determine the magnitude of force P, such that net deformation in the bar doesnot exceed 1mm. E for steel is 200GPa and that of aluminium is 70GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. **(08 Marks)**

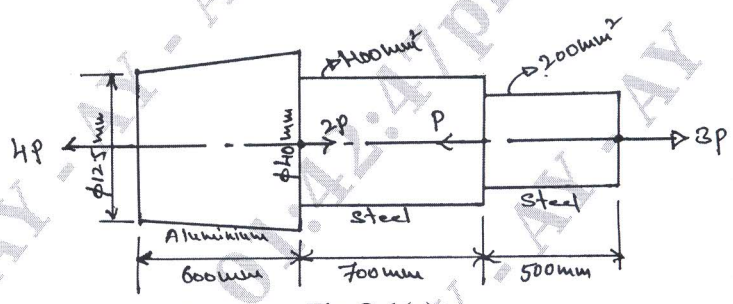

Fig.Q.1(c)

OR

2 a. Derive an expression for relation between E, G and μ as $E = 2G(1 + \mu)$. **(08 Marks)**

b. Define Elastic constants. **(04 Marks)**

c. A steel rod of cross-sectional area 1600mm^2 and two brass rods each of cross-sectional area of 1000mm^2 together support a load of 50kN as shown in Fig.Q.2(c). Find the stresses in the rods. E for steel = 2×10^5N/mm^2, E for brass = 1×10^5 N/mm^2. **(08 Marks)**

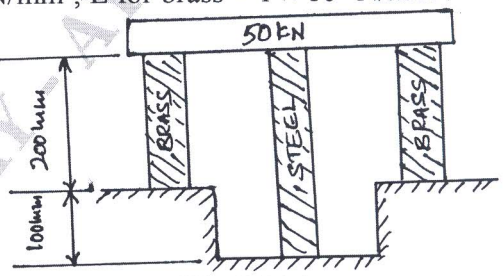

Fig.Q.2(c)

Module-2

3 a. Define principle stresses and principle planes. **(04 Marks)**

b. Derive the expression for a rectangular bar is subjected to two direct stresses σ_x and σ_y two mutually perpendicular directions. Prove that the normal stress (σ_n) and shear stress (τ) on an oblique plane which is Inclined at an θ with the axis of minor stress, an given by

$$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta \text{ and } \tau = \frac{-\sigma_x + \sigma_y}{2}\sin 2\theta$$ **(08 Marks)**

c. At a certain point in a strained material the values of the 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 CW on the plane carrying 80MPa stresses across the planes as shown in Fig.Q.3(c). Determine:

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

ii) Maximum shear stress and specify its plane. **(08 Marks)**

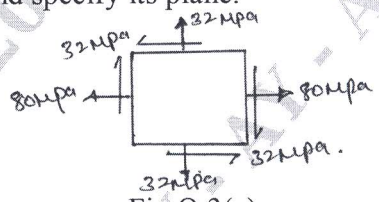

Fig.Q.3(c)

OR

4 a. Explain Sign conventions for Mohr's Circle. **(04 Marks)**

b. The state of stress in two dimensionally stressed body is shown in Fig.Q.4(b). Determine the principal stresses, principal planes, maximum shear stress and their planes. Also draw the Mohr's circle to verify the results obtained analytically. **(16 Marks)**

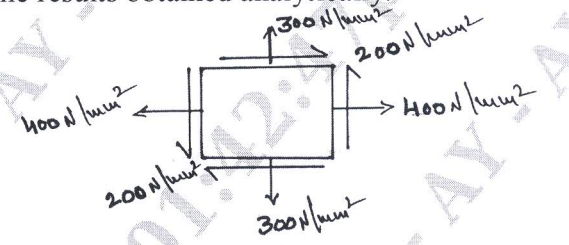

Fig.Q.4(a)

Module-3

5 a. Define Beam. Explain with simple sketches, different types of beams. **(06 Marks)**

b. A cantilever beam subjected to udl and point loads as shown in Fig.Q.5(b). Draw shear force diagram and bending moment diagram. **(14 Marks)**

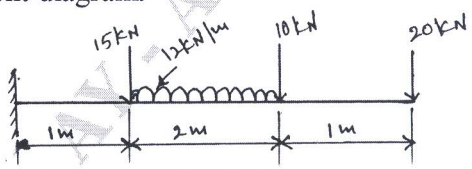

Fig.Q.5(b)

OR

6 a. Explain the following:

i) Shear force

ii) Bending moment

iii) Sagging Bending moment

iv) Hogging Bending moment

v) Point of contrafluxture. **(05 Marks)**

b. Draw shear force and Bending moment diagram for the beam as shown in Fig.Q.6(b). Locate the point of contrafluxture. **(15 Marks)**

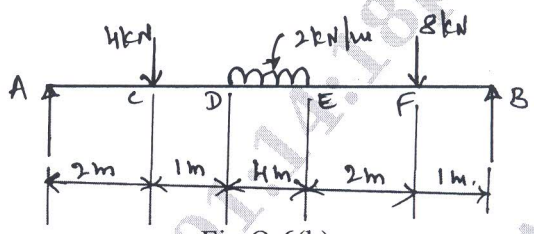

Fig.Q.6(b)

Module-4

7 a. With assumptions derive bending moment equation $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$. **(10 Marks)**

b. An 'I' section has flanges of width 'b' and over all depth 2b. The flanges and the web are of uniform thickness t. Find the ratio of maximum shear stress intensity to the mean shear stress intensity. **(10 Marks)**

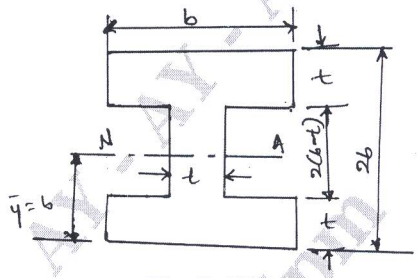

Fig.Q.7(b)

OR

8 a. Derive Euler Bernouli equation for deflection. **(10 Marks)**

b. Derive an expression for maximum deflection in a cantilever beam subjected to a point load at free end. **(10 Marks)**

Module-5

9 a. With assumptions, Derive Torsion equation for circular shaft. **(10 Marks)**

b. A hollow circular steel shaft has to transmit 60kW at 210rpm such that the maximum shear stress does not exceed $60MN/m^2$. 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)**

OR

10 a. Define slenderness ratio and derive Euler's Expression for buckling load for column with both Ends hinged. **(10 Marks)**

b. A hollow circular section 2.8m long column is fixed at one end and hinged at the other end. External diameter is 150mm and thickness of wall is 15mm. Ranking constant = $\frac{1}{1600}$ and σ_c = 550MPa. Compare the buckling loads obtained by using Euler's formula and Rankine formula. Also find the length of column for which both formulae gives the salve load. Take E = 80GPa. **(10 Marks)**

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