June 6, 2024 02:30 pm - 05:30 pm 1T01433 - S.E.(Mechanical) Engineering)(SEM-III)(Choice Base Credit Grading System) ((R- 19) (C Scheme) / 51622 - Strength of Materials QP CODE : 10057349

Time: 3 Hours **Total Marks: 80**

- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate the answers with sketches, wherever required.

I Answer any four of the following:

a. Draw stress-strain diagram for ductile material and explain its salient points. **(05)**

b. A simply supported beam of length 3m and cross section 100mm (width)×200mm (depth) carrying a uniformly distributed load of 4kN/m. Neglecting weight of beam. Determine maximum bending stress and maximum shear stress in beam. **(05)**

c. State the assumptions made in bending. Also state bending formula. **(05)**

d. Determine the maximum shear stress developed in a hollow circular shaft with internal diameter 50mm and external diameter 80mm, which transmits power of 15kW at a speed of 300rpm. **(05)**

e. Determine moment of inertia of the shaded area of the section given below (Fig.1) about centroidal x-x axis. **(05)**

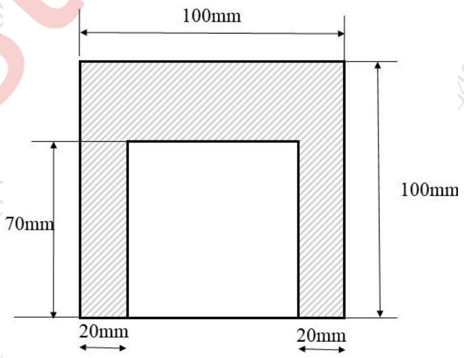

Fig.1

f. State the assumptions made in Euler's theory made in analysis of columns with its limitation. **(05)**

II a) A hollow steel shaft 150mm internal diameter and 300mm external diameter, it is to be replaced by solid shaft. If polar section modulus has the same value for both shafts, calculate: the diameter of solid shaft and ratio of torsional rigidities. Modulus of rigidity (G) for hollow shaft is two times modulus rigidity (G) of solid shaft. Assume same length for both shafts. **(10)**

II b) A steel bar (shown in fig.2) consists of two equal portions each 1m long, the respective diameters of each portion being 30mm and 50mm. Find the total strain energy of the bar when it is subjected to an axial pull of 150KN. Take E=200×10^3 N/mm^2 for steel. **(10)**

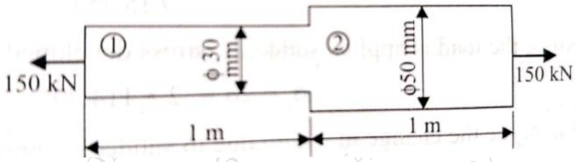

Fig.2

III a) A simply supported beam carries uniformly distributed load over a span of 5m with intensity of 2.5kN/m, with X-section is T-section having flange 125mm×25mm and web 25mm×175mm. Determine shear stress for various section of beam also draw shear stress distribution for given section. **(10)**

III b) Draw shear force and bending moment diagram for beam shown in fig. 3 and locate point of contra-flexure. **(10)**

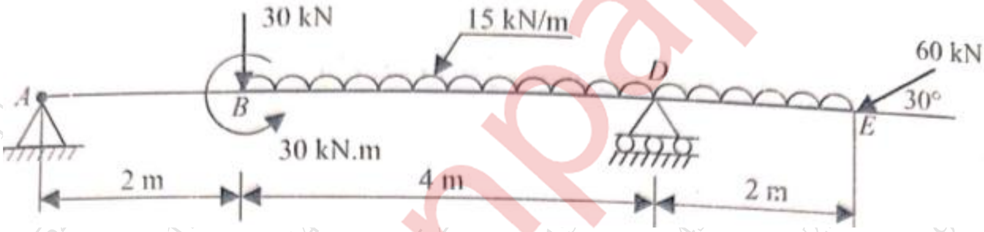

Fig.3

IV a) A composite bar made up of Aluminium and Steel which is held between two supports shown in fig. 4. The bars are stress free at a temperature of 38°C. Determine the stresses in two bars when temperature reaches to 21°C if i) The supports are unyielding and ii) The supports come nearer to each other by 0.1mm. Take Es= 210GPa E_{Al} = 74GPa, α_s = 11.7×10^{-6}/°C, α_{Al} = 23.4×10^{-6}/°C. **(10)**

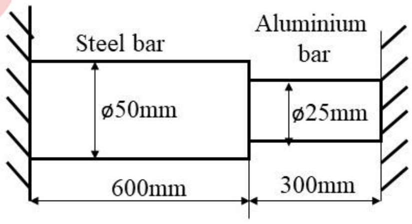

Fig.4

IV b) Find the slope deflection at a point C for the beam loaded shown in fig.5. Assume moment of inertia and modulus of elasticity as I and E. **(10)**

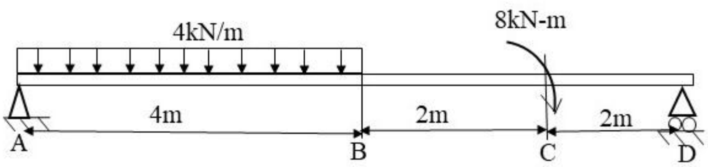

Fig. 5

V a) Two mutually perpendicular plane of an element subjected to σ_x =105MPa (tensile) and σ_y =35MPa (compressive). Locate the principal planes and determine the principal stresses, maximum shear stresses using Mohr's circle verify answers with analytical method. **(10)**

V b) Determine the outside diameter of a hollow cylindrical column 6m long with ends firmly fixed. The ratio of external to internal diameter is 1.3 and carries on an axial load of 500kN. Consider factor of safety as 6. Take σ_c= 500N/mm^2, and Rankine constant = $\frac{1}{1600}$ **(10)**

VI a) Find the load per meter run which can carry over a span of 4m by simple supported beam for cross section shown in fig.6, if the maximum permissible stresses are 90MPa in compression and 40MPa in tension. **(10)**

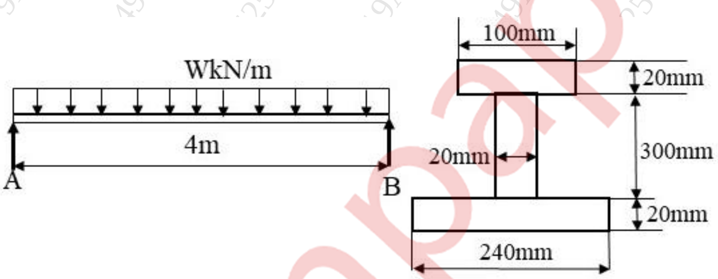

Fig. 6

VI b) A thin cylindrical shell, 3m long and 1m in diameter, is subjected to an internal pressure of 1N/mm^2. If thickness of shell is 12mm, find the circumferential and longitudinal stresses. Also find maximum shear stress and change in dimension of shell. Take E= 2×10^5 N/mm^2 and Poisson's ratio =0.3 **(10)**
