CBCS SCHEME

USN | | | | | | | | | | | **15AU34**

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive an expression for analysis of uniformly tapering circular bar. **(08 Marks)**

b. Determine the stresses in various segments of the circular bar shown in Fig.Q1(b). Compute the total elongation taking Young's modulus to be 195 GPa.

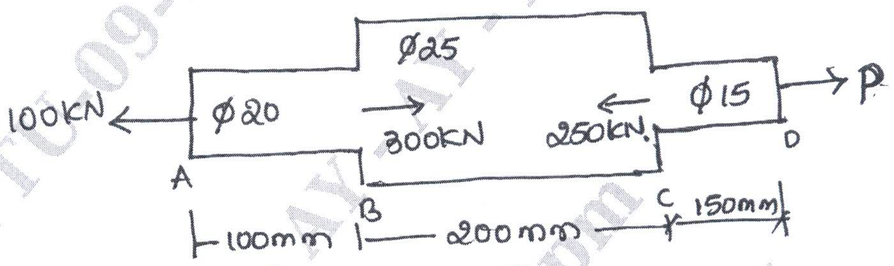

Fig.Q1(b) **(08 Marks)**

OR

2 a. Briefly explain the following:
(i) Hooke's law
(ii) Poisson's ratio
(iii) Bulk modulus
(iv) Stress and strain **(08 Marks)**

b. A composite bar made up of aluminium and steel is held between two supports as shown in Fig.Q2(b). The bars are stress free at temperature 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 0.1 mm.
The cross-sectional area of steel bar is 160 mm^2 and that of aluminium bar is 240 mm^2. $E_A = 0.7 \times 10^5$ N/mm^2, $E_S = 2 \times 10^5$ N/mm^2, $\alpha_A = 24 \times 10^{-6}$ per °C and $\alpha_S = 12 \times 10^{-6}$ per °C.

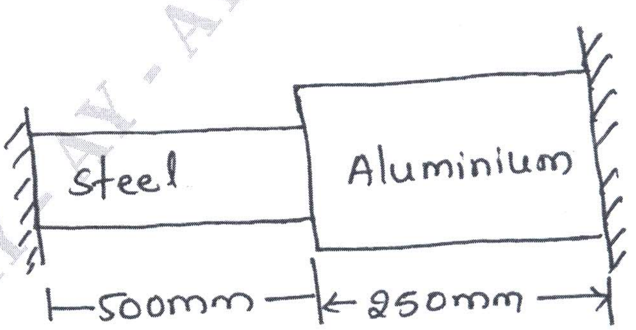

Fig.Q2(b) **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-2

3 At certain point in a strained material the stress condition shown in Fig.Q3(a) exists. Find:
(i) Normal and shear stresses on the inclined plane AB.
(ii) Principal stresses and principal planes
(iii) Maximum shear stresses and their planes.

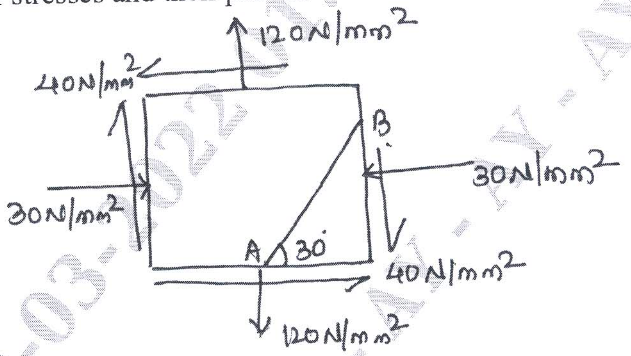

Fig.Q3(a) **(16 Marks)**

OR

4 a. Derive an expression for circumferential and longitudinal stress in thin cylindrical shell. **(08 Marks)**

b. A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Find the maximum and minimum hoop stress across the cross-section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. **(08 Marks)**

Module-3

5 a. Mention different types of loads and beam. **(02 Marks)**

b. Draw SFD and BMD for a overhanging beam shown in Fig.Q5(b) and locate the point of contra-flexure.

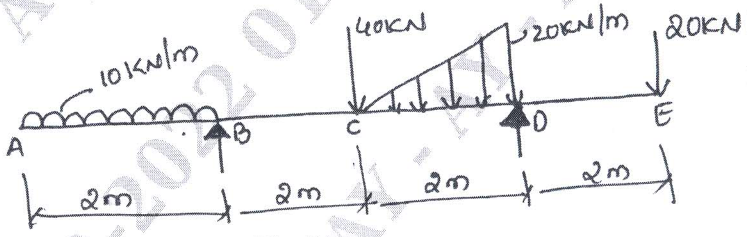

Fig.Q5(b) **(14 Marks)**

OR

6 a. Derive an expression for relationship between bending stress and radius of curvature. **(10 Marks)**

b. A simply supported beam 100 mm × 200 mm carries a central concentrated load W. The permissible stress in bending and shear are 15 N/mm^2 and 1.2 N/mm^2 respectively. Determine the safe load W if the span of beam is 3m. **(06 Marks)**

Module-4

7 a. State the assumption made in pure torsion and derive $\frac{T}{J_p} = \frac{\tau}{R} = \frac{G\theta}{\ell}$. **(12 Marks)**

b. Determine the diameter of the solid shaft which will transmit 440 KW at 280 rpm, if maximum torsional shear stress is to be limited to 40 N/mm^2. Assume G = 84 kN/mm^2. **(04 Marks)**

OR

8 a. Derive an expression for the critical load in a column subjected to compressive load when both the ends are hinged. **(10 Marks)**

b. A solid round bar of 60 mm diameter and 2.5 m is used as a strut. Find the safe compressive load for the strut if (i) both ends are hinged (ii) both ends are fixed.
Take $E = 2 \times 10^5$ N/mm^2 and factor of safety = 3. **(06 Marks)**

Module-5

9 a. A simply supported beam of span 'ℓ' carries a point load 'p' at mid-span. Determine the strain energy stored by the beam. Also find the deflection at mid span. **(08 Marks)**

b. Derive an expression for strain energy stored in a body due to shear stress. **(08 Marks)**

OR

10 a. State and prove Castigliano's I and II theorem. **(10 Marks)**

b. A plate of 45C8 steel (σ_{yt} = 353 MPa) is subjected to the following stresses.
σ_x = 150 N/mm^2, σ_y = 100 N/mm^2 and τ_{xy} = 50 N/mm^2. Find the factor of safety by
(i) Maximum principal stress theory
(ii) Maximum shear stress theory **(06 Marks)**

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