CBCS SCHEME

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18CV32

Third Semester B.E. Degree Examination, July/August 2021
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions.***
2. ***Missing data, if any, may be suitably assumed.***

1 a. Define: (i) Poisson's ratio (ii) Volumetric strain (ii) Temperature stresses **(06 Marks)**

b. A steel bar of 20 mm diameter is subjected to tension test in lab. Determine stress, strain, Young's Modulus Percentage elongation from the following data:
Gauge length – 200 mm, extension at a load of 100 kN is 0.147 mm, total elongation 50 mm. also determine the percentage decrease in cross sectional area of the specimen. If the diameter of the rod at failure is 16 mm. **(10 Marks)**

c. Derive an expression for extension/shortening of bar of uniform cross sectional area. **(04 Marks)**

2 a. Derive the relationship between Young's modulus and shear modulus with usual notations. **(06 Marks)**

b. A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 kN is applied the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find the Poisson's ratio, Young's modulus, bulk modulus and modulus of rigidity. **(08 Marks)**

c. Show that volumetric strain is sum of strains in three mutually perpendicular directions. **(06 Marks)**

3 a. Derive an expression for change in volume of thin cylinders. **(10 Marks)**

b. For a state of stresses with σ_x = 85 MPa (tensile) σ_y = 60 MPa (compressive) with a shear stress of 45 MPa, determine the principal stresses and locate their planes. Also obtain maximum tangential stress and locate corresponding planes. [Refer Fig.Q3(b)]

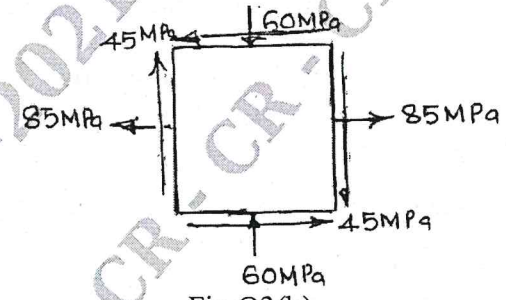

Fig.Q3(b) **(10 Marks)**

4 a. Derive an expression for normal and tangential stresses on a plane inclined at an angle θ with plane of σ_x for an element subjected to general two dimensional stress system and show that:
(i) Sum of normal stresses in any two mutually perpendicular directions is constant.
(ii) Principal planes are planes of maximum normal stresses also. **(10 Marks)**

b. Find the thickness of metal necessary for a steel cylindrical shell of internal diameter 150 mm to withstand an internal pressure of 50 N/mm^2. The maximum hoop stress in the section is not to exceed 150 N/mm^2. If the thickness of cylinder is found using thin cylinder analysis, what is the percentage error? **(10 Marks)**

5 a. Derive relationship between load intensity, shear force and bending moment. **(06 Marks)**

b. Draw SFD and BMD for a simply supported beam subjected to a couple moment 'M' in clockwise direction acting at a distance of 'a' from left support and 'b' from right support. **(06 Marks)**

c. Draw SFD and BMD for a cantilever beam subjected to loads as shown in Fig.Q5(c).

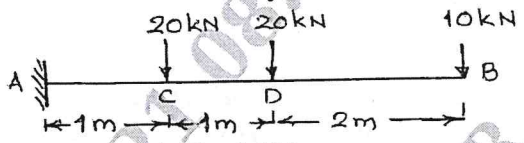

Fig.Q5(c) **(08 Marks)**

6 a. Define: (i) Shear force (ii) Bending moment (iii) Point of contraflexure **(06 Marks)**

b. Draw BMD and SFD for the overhanging beam shown in Fig.Q6(b). Clearly indicate the point contraflexure.

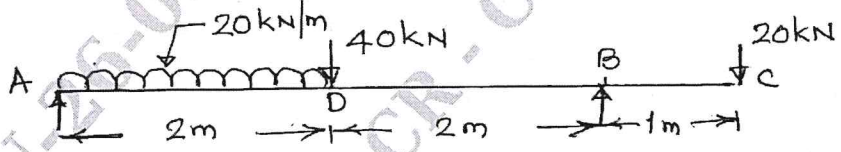

Fig.Q6(b) **(14 Marks)**

7 a. List the assumptions made in simple theory of bending. **(04 Marks)**

b. Derive the bending equation with usual notations. **(08 Marks)**

c. A solid shaft transmits 250 KW at 100 rpm. If the shear stress is not to exceed 75 MPa, what should be the diameter of the shaft? If this shaft is to be replaced by a hollow one whose diameter ratio is 0.6. Determine the size and percentage saving in weight. The maximum shear stress being the same. **(08 Marks)**

8 a. Derive the torsion equation for a circular shaft $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notations. **(10 Marks)**

b. A simply supported beam 100 mm × 200 mm in cross section carries a central concentrated load 'W'. The permissible stress in bending and shear are 15 MPa and 1.2 MPa respectively. Determine the safe load W, if the span of the beam is 3m. **(10 Marks)**

9 a. Derive the moment curvature equation of deflection. **(06 Marks)**

b. Find the Euler's crippling load for a hollow cylindrical steel column of 40 mm diameter and 4 mm thick. Take the length of column as 2.3 m and column is hinged at both the ends. Also determine the crippling load by Rankine's formula using constants as 335 MPa and $\frac{1}{75000}$.

Take $E = 205 \times 10^3$ N/mm^2. **(10 Marks)**

c. What are the limitations of Euler's theory of buckling? **(04 Marks)**

10 a. Derive an expression for a column when both the ends are pinned. **(06 Marks)**

b. Determine the slope and deflection at free end of a cantilever beam of span 'L' subjected to udl w/m over its full length by using Macaulay's method. **(06 Marks)**

c. Find the maximum value of slope and deflection for a simply supported beam subjected to point load at centre use Macaulay's method. **(08 Marks)**

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