CBCS SCHEME

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18CV32

Third Semester B.E. Degree Examination, June /July 2025
Strength of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Show that volumetric strain is equal to algebraic sum of the strains in three mutually perpendicular directions in case of cuboid. **(05 Marks)**

b. Calculate the diameter of steel rod needed to carry a load of 8 KN, if the extension is not to exceed 0.04 percent. Assume E = 210 GN/m^2. **(05 Marks)**

c. A reinforced concrete column 300mm × 300mm in size has 4 reinforcement bars of steel 20 mm in diameter. Calculate the safe load, the column can carry if the permissible stress in concrete is 5.2 MN/m^2. Take $E_{steel} / E_{concrete} = 18$. **(10 Marks)**

OR

2 a. Derive an expression for change in length in case of a uniformly varying circular cross section whose diameter varies from d_1 to d_2 over a length 'L' subjected to an axial force F. **(06 Marks)**

b. A rod is 2 m long at a temperature of 10°C. Find the expansion of the rod when the temperature is raised to 80°C. If this expansion is prevented, find the stress induced in the material of the rod. Take E = 1.0×10^5 MPa and $\alpha = 12 \times 10^{-6}/°C$. **(05 Marks)**

c. A bar of cross section 10mm × 10mm is subjected to an axial pull of 8000N. The lateral dimension of the bar is found to be changed to 9.9985mm × 9.9985mm. If the modulus of rigidity is 0.8×10^5 N/mm^2, determine the Poisson's ratio and modulus of elasticity. **(09 Marks)**

Module-2

3 a. Show that the planes of maximum shear stresses are inclined at 45° with the principal planes. **(06 Marks)**

b. The state of stress in a two dimensionally stressed body is shown in fig. Q.3 (b) . Determine the principal planes, principle stresses, maximum shear stress and their planes. **(14 Marks)**

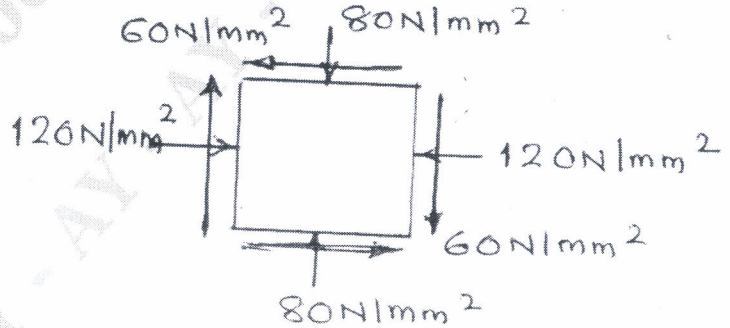

Fig.Q.3(b)

OR

4 a. Derive Lame's equation for radial and hoop stresses for thick cylinder subjected to internal and external fluid pressure. **(08 Marks)**

b. A thick cylindrical vessel is 250mm in internal diameter and has 50mm thick walls. It is subjected to an internal pressure of 10MPa due to movement of fluid. Find the maximum hoop stress developed. Also calculate the radial and hoop stress at a point 20 mm from the inside surface. **(08 Marks)**

c. A thin cylinder is 3m in length, 1m in diameter and has a metal thickness of 12mm in its walls. Determine the stresses (Hoop and Longitudinal) and strain along the length when subjected to an internal pressure of 1.5 MPa. Take E = 210 GPa $\mu = 0.25$. **(04 Marks)**

Module-3

5 a. For a cantilever beam subjected to a udl of intensity w/unit length throughout, draw SFD and BMD. **(06 Marks)**

b. For the beam shown in Fig.Q.5(b), draw SFD and BMD indicating salient values. Find the point of contraflexure, if any. **(14 Marks)**

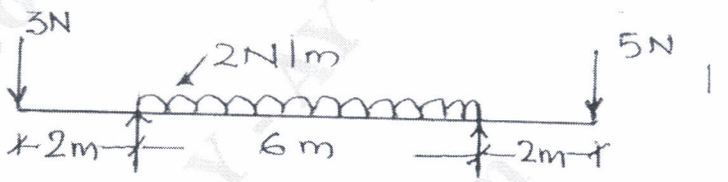

Fig.Q.5(b)

OR

6 a. For a simply supported beam subjected to uniformly varying load of w/unit length draw SFD and BMD. **(08 Marks)**

b. For the beam shown in fig. Q. 6(b) find the load P to have equal reactions at A and C. Draw the SFD and BMD indicating values at significant points. Locate the point of contraflexure. **(12 Marks)**

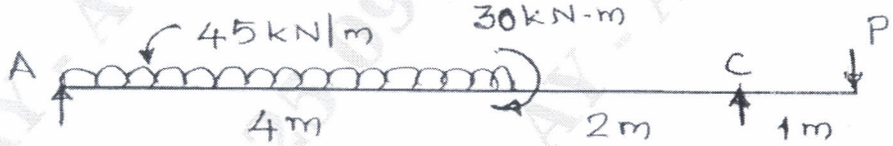

Fig. Q. 6(b)

Module-4

7 a. Define section Modulus and Moment of Resistance. **(04 Marks)**

b. Derive the relationship between bending stress and radius of curvature. **(06 Marks)**

c. The T – section shown in fig Q.7 (c) is subjected to a shear force of 100KN, Draw shear stress distribution diagram and find maximum shear stress. **(10 Marks)**

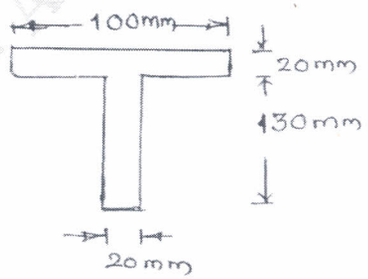

Fig. Q. 7(c)

OR

8 a. Derive the expression for power transmitted by a shaft. **(05 Marks)**

b. List the assumptions made in the theory of torsion. **(05 Marks)**

c. A hollow steel shaft transmits 200KW of power at 180 rpm. The total angle of twist in a length of 5m of the shaft is 3°. Find the inner and outer diameter of the shaft. If the permissible shear stress is 60MPa take G = 80GPa. **(10 Marks)**

Module-5

9 a. For a simply supported beam subjected to a udℓ of w N/m , determine the magnitude of maximum deflection using double integration method. **(10 Marks)**

b. An overhanging beam ABC is loaded as shown in fig Q.9 (b). Determine the slope and deflection at its free end C. Take $E = 2 \times 10^5$ N/mm^2 and $I = 5 \times 10^8$ mm^4. **(10 Marks)**

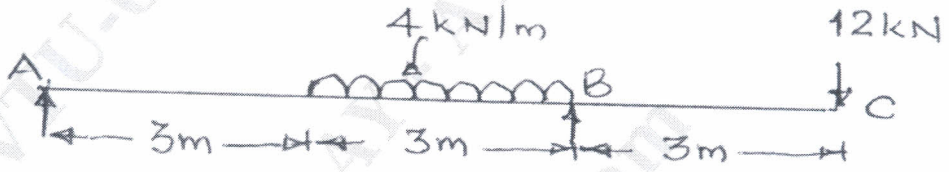

Fig. Q.9 (b)

OR

10 a. Derive the Euler's equation for buckling load on a column with one end fixed and other end hinged. **(10 Marks)**

b. A hollow cast iron column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a FOS of 4. Calculate the ration of Euler's and Rankine's critical loads for cast iron.

Take $\alpha = \frac{1}{1600}$, $\sigma_c = 550 N/mm^2$, $E = 8 \times 10^4 N/mm^2$ **(10 Marks)**

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