CBCS SCHEME

USN

18CV32

Third Semester B.E. Degree Examination, June/July 2023
Strength 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 be suitably assumed.

Module-1

1 a. Draw a typical stress-strain curve for behavior of a mild steel rod during tension test. Show salient points on the graph and briefly explain them. **(06 Marks)**

b. Derive an expression for deformation of a circular tapered bar, subjected to axial tensile force 'P'. **(06 Marks)**

c. A composite section made up of steel with 100mm internal diameter and 120mm external diameter is fitted inside a bruss tube of 140mm internal diameter and 160mm external diameter, under a compressive load of 500kN. Determine stress in both materials. $E_s = 200 \times 10^3 N/mm^2$, $E_b = 100 \times 10^3 N/mm^2$. Also determine deformation if length of bar is 1500mm. **(08 Marks)**

OR

2 a. Determine the net deformation of a stepped circular bar with different forces as shown in Fig.Q.2(a). Take Young's modulus $E = 210kN/mm^2$.

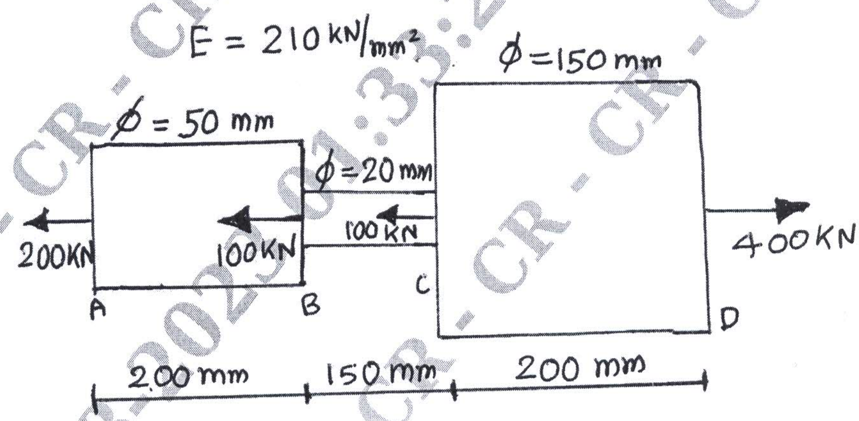

Fig.Q.2(a)

(08 Marks)

b. Establish a relation between modulus of elasticity (E), modulus of rigidity (G) and Poisson's ratio (μ). **(06 Marks)**

c. A steel rod of 20m length is at 20°C. Find the expansion of the rod if the temperature rises to 65°C. Also find temperature stresses for following:
i) When expansion is fully prevented?
ii) An expansion of 5.8mm is allowed.
If the temperature stress in the rod is $35N/mm^2$, what is permitted expansion in the rod? Assume E = 200GPa and $\alpha = 12 \times 10^{-6}/°C$. **(06 Marks)**

Module-2

3 a. For the 2-D stress system in the Fig.Q.3(a) find the following:

i) Principal stresses
ii) Maximum shear stress
iii) Corresponding normal stress
iv) Principal planes
v) Plane of maximum shear.

(10 Marks)

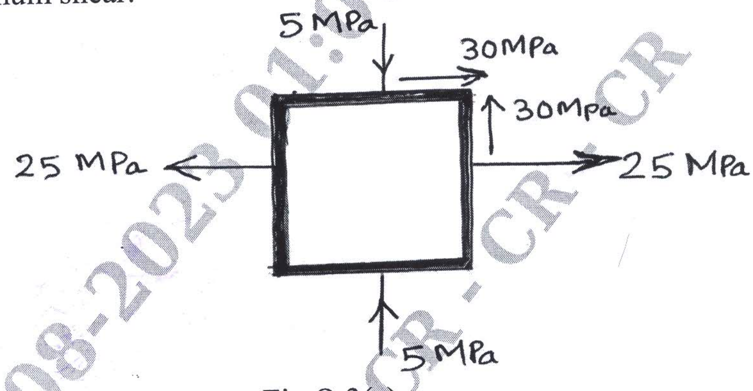

Fig.Q.3(a)

b. Briefly explain following:

i) Maximum shear stress theory
ii) Maximum principal stress theory.
iii) Mohr's circle.
iv) Generalized 2-D stress system.
v) Principal stresses and planes.

(10 Marks)

OR

4 a. A thin cylindrical shell 5m long and 1.5m in diameter is subjected to an internal fluid pressure of 6MPa. The thickness of the shell is 15mm. Determine the circumferential and longitudinal stresses. Also determine the maximum shear stress and changes in the dimensions. Assume E = 200GPa and Poisson's ratio $\mu = 0.3$. (08 Marks)

b. Differentiate between thin and thick cylinders. Also briefly explain the various stresses involved in both types of cylinders. (06 Marks)

c. Determine the maximum and minimum hoop stresses across the section of a pipe of 400mm internal diameter and 100mm thick, when a pipe contains a fluid at a pressure $8 N/mm^2$. Also sketch the radial pressure and hoop stress distribution across the section. (06 Marks)

Module-3

5 a. Draw SFD and BMD for the beam shown in Fig.Q.5(a). Also locate the point of contraflexure if any.

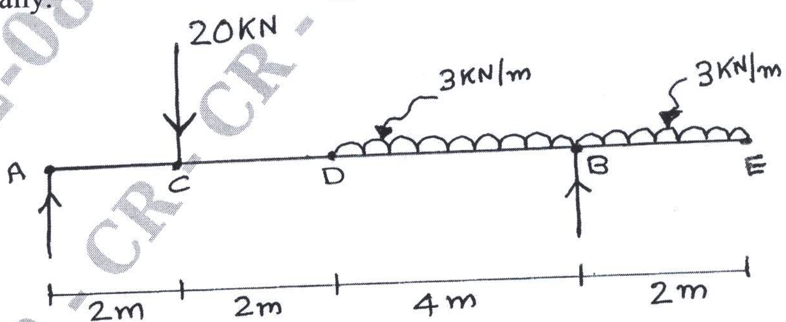

Fig.Q.5(a)

(10 Marks)

b. Draw SFD and BMD for the beam shown in Fig.Q.5(b).

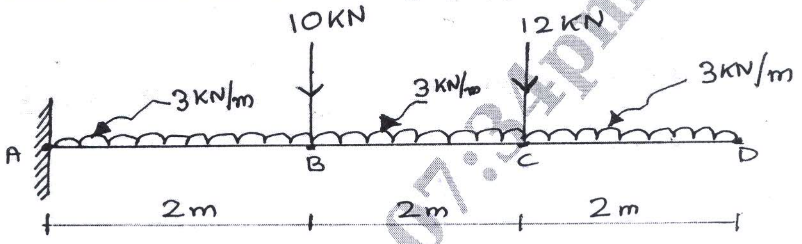

Fig.Q.5(b)

(06 Marks)

c. Draw SFD and BMD for following standard loading cases on a simply supported beam.
i) UDL on complete span ii) A moment at the centre. **(04 Marks)**

OR

6 a. Derive expression for relation between UDL intensity, shear force and bending moment. **(06 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q.6(b). Locate point of contraflexure if any.

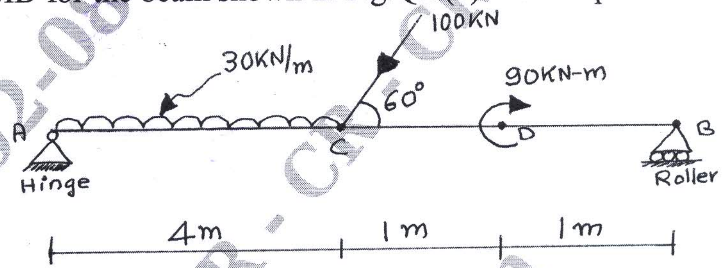

Fig.Q.6(b)

(10 Marks)

c. Briefly explain following:
i) Shear force
ii) Bending moment
iii) Types of supports
Draw sketches if necessary. **(04 Marks)**

Module-4

7 a. Derive the bending equation stating the necessary assumptions. **(10 Marks)**

b. A cast iron beam is of T-section as shown in Fig.Q.7(b). The beam is simply supported on a span of 8m. The beam carries a UDL of intensity 1.5kN/m over entire span. Determine the maximum tensile and maximum compressive stresses.

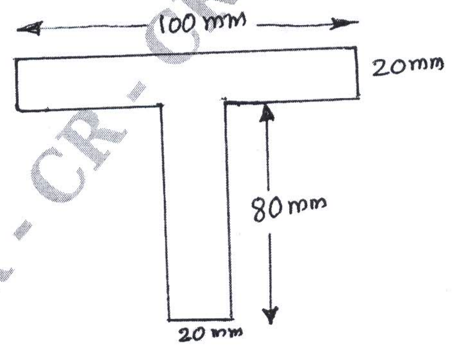

Fig.Q.7(b)

(06 Marks)

c. Define following:
   i) Section modulus
   ii) Moment of resistance
   iii) Pure bending
   iv) Modulus of rupture. (04 Marks)

OR

8 a. Derive Torsion equation stating the assumptions. (08 Marks)

b. Determine the diameter of a solid shaft which will transmit 300kW at 250r.p.m. The maximum shear stress should not exceed $30N/mm^2$ and twist should not be more than 1° in a shaft length of 2m. Assume rigidity modulus as $1 \times 10^5 N/mm^2$. (08 Marks)

c. Define following:
   i) Pure Torsion
   ii) Torsional rigidity
   iii) Polar modulus. (04 Marks)

Module-5

9 a. A beam of 6m is simply supported at ends and carries two point loads 48kN and 40kN at a distance 1m and 3m respectively from left support. Determine:
   i) Deflection under each load.
   ii) Maximum deflection
   iii) Point of maximum deflection.

   Assume $E = 2 \times 10^5 N/mm^2$ and $I = 85 \times 10^6 mm^4$. Adopt Macaulay's method. (10 Marks)

b. A beam of uniform section and constant depth is freely supported over a span of 3m. It carries a point load of 30kN at the mid span. Take $I_{xx} = 15.614 \times 10^{-6} m^4$. Determine:
   i) Central deflection
   ii) Slopes at the ends.

   Take E = 200GPa and use double integration method. (06 Marks)

c. Derive an expression for relation between slope, deflection and radius of curvature. (04 Marks)

OR

10 a. State the assumptions made in the Euler's column theory. (04 Marks)

b. Derive expression for crippling load when both ends of the column are hinged. (06 Marks)

c. A hollow cylindrical cast iron column is 4m long with both ends fixed. Determine the minimum diameter of the column if it has to carry a safe load of 250kN with a factor of safety of 5. Internal diameter is 0.8 times external diameter. $\sigma_c = 550N/mm^2$, $\alpha = \frac{1}{1600}$ in Rankine's formula. (10 Marks)

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