B.E. Mechanical Engineering (Model Curriculum) Semester-IV

PCCME204 Strength of Materials

P. Pages : 3 **GUG/W/23/14064**

Time : Three Hours * 7 6 5 1 * Max. Marks : 80

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. I.S. Hand Book for structural steel section, I.S. Code 8000/1962 or 1964, I.S. 456 (Revised), I.S. 875 may be consulted.
5. Attempt Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10.

1. a) Explain thermal stress and thermal strain with example. **4**

b) Define principal plane and principal stresses. **4**

c) Determine the stress in each section of the bar as shown in fig. 1© when subjected to an axial tensile load of 20kN. Also determine total extension of the bar. Take E = 200 GPa. **8**

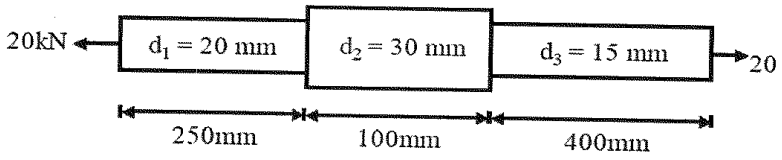

Fig. 1(c)

OR

2. a) Derive the relationship between young's modulus of elasticity (E), modulus of rigidity (G) and Poisson's ratio (μ). **6**

b) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at the elastic limit 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm find, **10**
i) The stress at elastic limit
ii) Young's modulus
iii) Percentage elongation
iv) percentage reduction in area
v) Ultimate tensile stress.

3. Draw S.F. and B.M diagram for the beam loaded as shown in fig. 3 and determine **16**
i) The position and magnitude of the maximum B. M. and
ii) The position of any point of contraflexure.

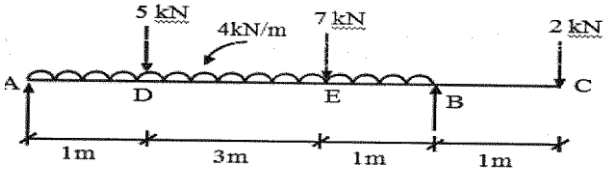

Fig. 3

OR

4. a) A 0.5 m long cantilever is 20 mm x 40 mm in section is subjected to a load of 250 N at free end. Determine bending stresses. **8**

i) At the top of the beam
ii) At centroid of the beam
iii) At 10 mm from the bottom of the beam and
iv) At the bottom of the beam.

b) A hollow circular shaft with d/D = 3/8 is supported in two bearings A and B which are 2 m apart. It carries flywheel of weight 500 N at its center. Determine inner diameter (d) and outer diameter D, of the shaft, so that the maximum Bending stress induced in shaft should not exceed 70 MPa. **8**

5. a) Derive the differential equation of flexure of a beam $EI\frac{d^2y}{dx^2} = M$ **6**

b) A beam is 10m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at distances of 2m and 5 m respectively from the left end. Calculate the deflection under each load. Find also the maximum deflection. Take I = 10 x 10^8 mm^4 and E = 200 kN/mm^2 use Macaulay's method. **10**

OR

6. a) A shaft made of SAE 1030 is having diameter 'D' is supported in two bearing A and B which are 2 meter apart. A shaft carries a gear G having weight W_g = 300N. Also it transmits power of 75 kw at 220rpm. Determine the diameter of shaft 'D' required if fos used in design is 3. **8**

b) Two solid shafts of different materials are rigidly fastened together and attached to rigid supports as shown in fig.6 (b). The torque T = 11kN. m is applied at the junction of two shaft. Determine the maximum torsional shear stress developed in AL and St shaft Take $G_{A1} = 30\,Gpa$ and $G_{st} = 80Gpa$. Also find angle of twist in both the shaft. **8**

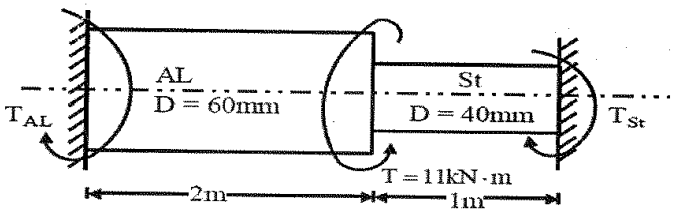

fig.6 (b)

7. A simply supported beam ABCD of span 4m. with AB = 1m, Bc = 2m and CD = 1m, supported at A and D. The beam carries a UDL of 15kN/m. on the span BC and concentrated loads of 22kN and 32kN at points B and C. Determine slope and deflections at point B and C. Also find Max_m deflection y_{max}, Take EI = 68500kN.m^2 **16**

OR

8. a) Define the 'column' and strut' with example. **3**

b) Explain the failure of 'short column' and 'Long column'. **4**

c) Derive the expression for the crippling load when one end of the column is fixed and the other end free. **9**

9. a) Show that strain energy stored in the bar when subjected to moment 'M' is given by **8**

$$U = \frac{M^2 L}{2EI} \text{ if M is constant over a length 'L'}$$

b) A tensile load of 40 kN is suddenly applied to a circular bar of 50 mm diameter and 4m long. If value of E = 200 GPa. Determine **8**

i) Strain energy absorbed by bar and

ii) Stress in the bar.

OR

10. Write short notes on **any four.** **16**

a) Stress – Strain Diagram for mild steel and C. I.

b) Modulus of Elasticity Modulus of Rigidity and Poisson's ratio and their significance.

c) Factor of safety and it's selection.

d) Assumptions made in derivation of Bending Equation.

e) Strength and rigidity criterion for shaft design.

f) Strength and rigidity criterion for Beam design.

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