

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

L 1138

B.E./B.Tech. DEGREE EXAMINATION, JUNE 2008.

Fourth Semester

Mechanical Engineering

(Common to Mechatronic Engineering)

CE 251 — STRENGTH OF MATERIALS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive a relation for change in length of a bar hanging freely under its own weight.
2. A short bar of length 100 mm tapers uniformly from a diameter 30 mm to a diameter of 20 mm and carries an axial compressive load of 200 KN. Find the change in length of the bar. $E = 200 \text{ KN/mm}^2$.
3. Define shear force and bending moment.
4. Sketch the bending and shear stress distribution for a "T" section.
5. Show that the shear stress distribution over a rectangular section is parabolic.
6. Define principal plane and principal stress.
7. A rectangular R.C simply supported beam of span 3 m and cross section 200 mm × 350 mm carries a point load of 100 KN at its mid span. Find the maximum slope and deflection of the beam if $E = 0.2 \times 10^5 \text{ N/mm}^2$.
8. State Castigliano's theorem for the deflection of beams.
9. Draw conjugate beam for a cantilever carrying uniformly distributed load over the entire span.
10. Give conjugate beams for the cantilever beam and simple supported beam.

PART B — (5 × 16 = 80 marks)

11. (a) A simply supported beam AB of uniform section, 4 m span is subjected to a clockwise moment of 10 KN.m applied at the light hinge B. Derive the equation to the deflected shape of the beam. Locate the point of maximum deflection and find the maximum deflection. (16)

Or

- (b) A steel rod of 20 mm passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates. If the temperature of the assembly is raised by 50°C, calculate the stresses developed in copper and steel. Take $E_s = 200 \text{ KN/mm}^2$, $E_c = 100 \text{ KN/mm}^2$, $\alpha_s = 12 \times 10^{-6} \text{ per}^\circ\text{C}$, $\alpha_c = 18 \times 10^{-6} \text{ per}^\circ\text{C}$.
12. (a) A simply supported beam is loaded as shown in Fig. Q. 12(a). Draw the shear force and bending moment diagrams. (16)

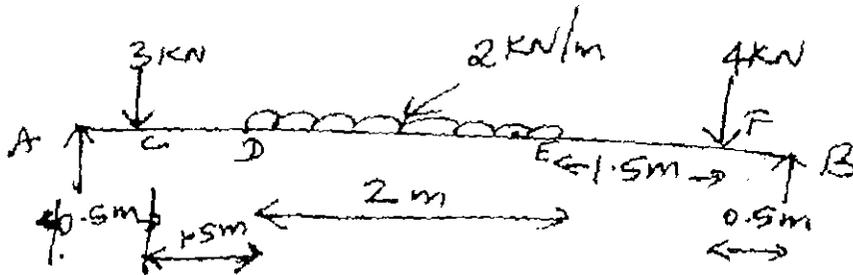


Fig. Q. 12(a)

Or

- (b) For the beam shown in Fig. Fig. Q. 12(b) find deflection at C and maximum deflection $EI = 360000 \text{ KNm}^2$. (16)

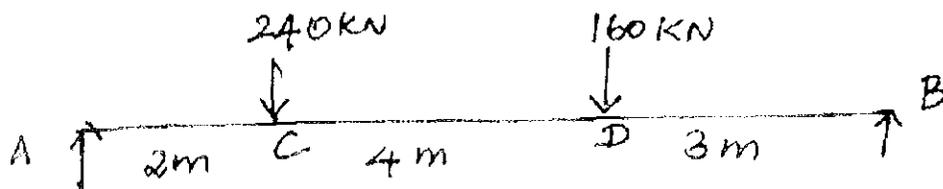


Fig. Q. 12(b)

13. (a) (i) State any four assumptions made in the theory of simple bending. (4)

(ii) Derive the bending formula $\frac{M}{I} = \frac{f}{g} = \frac{E}{R}$.

Or

(b) A thin cylindrical shell 1.5 m long, internal diameter 300 mm and wall thickness 10 mm is filled up with a fluid at atmospheric pressure. If the additional fluid of $300 \times 10^3 \text{ mm}^3$ is pumped in the shell, find the pressure exerted by the fluid on the shell. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $1/m = 0.3$. Also find the hoop stress induced.

14. (a) Stresses at a point are $p_x = 80 \text{ N/mm}^2$, $p_y = -35 \text{ N/mm}^2$ $q = 11.5 \text{ N/mm}^2$. Determine principal planes, principal stresses and maximum shear stress.

Or

(b) A solid shaft is subjected to a torque of 100 Nm. Find the necessary shaft diameter if the allowable shear stress is 100 N/mm^2 and allowable twist is 3° per 10 diameter length of the shaft. Take $C = 1 \times 10^5 \text{ N/mm}^2$.

15. (a) A cantilever of length $2a$ is carrying a load of W at the free end, and another load of W at its centre. Determine by moment area method, the slope and deflection of the cantilever at the free end.

Or

(b) Using energy method, find the slope at the ends of a simply supported beam carrying a point load of 50 kN at the centre of the span. Span = 6 m $EI = 360000 \text{ kN m}^2$.