

B. Tech 3rd Semester Examination

Mechanics of Solids-I (CBS)

CE-301

Time : 3 Hours

Max. Marks : 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five question in all by selecting at least one question each from Unit I-IV, question no. 9 is compulsory. Use of Non-Programmable calculator is allowed. Assume missing data if any.

UNIT - I

- (a) A bar having a cross-sectional area of 700 mm^2 is subjected to axial loads at the positions indicated in Fig. 1. The value of stresses and corresponding strains in all the segments. Take modulus of elasticity as 200 GPa .
- (b) Deduce the relation between elastic constants.

(5+5=10)



Fig. 1

- Draw the Mohr's Circle for the element shown in Fig. 2 to find the stress when it is inclined at 30° clockwise. Draw the corresponding stress elements. (10)

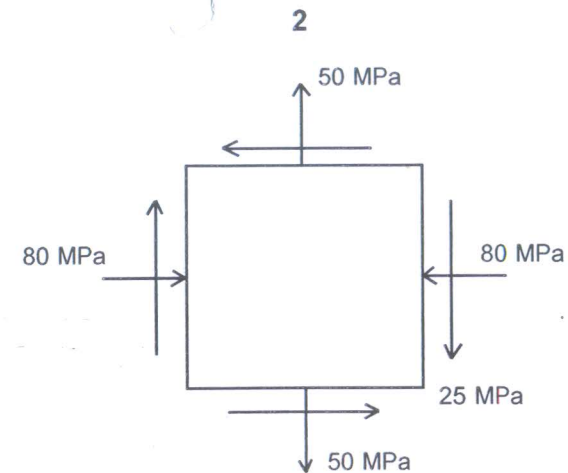


Fig. 2

UNIT - II

- Determine and draw the SFD and BMD for the beam shown in Fig. 3. (10)

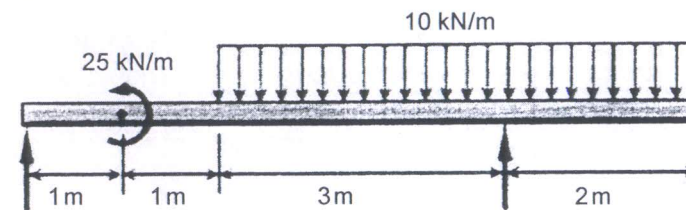


Fig. 3

- A simply supported beam made of rolled steel joist (I-section: $450 \text{ mm} \times 200 \text{ mm}$) has a span of 5 m and it carries a central concentrated load W . The flanges are strengthened by two $300 \text{ mm} \times 20 \text{ mm}$ plates, one riveted to each flange over the entire length of the flanges. The second moment of area of the joist about the principal bending axis is 35060 cm^4 . Calculate the greatest central load the beam will carry if the bending stress in the plates is not to exceed 125 MPa . (10)

[P.T.O.]

UNIT - III

5. (a) What is torsional rigidity? How is it different from polar modulus?
- (b) A hollow shaft and a solid shaft construction of the same material have the same length and the same outside radius. The inside radius of the hollow shaft is 0.6 times of the outside radius. Both the shafts are subjected to the same torque.
- (i) What is the ratio of maximum shear stress in the hollow shaft to that of solid shaft?
- (ii) What is the ratio of angle of twist in the hollow shaft to that of solid shaft? (3+7=10)
6. (a) What are the sign conventions associated with slope and deflection in a beam?
- (b) A cantilever of rectangular section 100 mm × 200 mm is 2 m long and carries a uniformly distributed load of 3 kN/m for a length of 1.25 m from fixed end and a point load of 1 kN at the free end. Find the deflection at free end by considering E as 10 GPa. (3+7=10)

UNIT - IV

7. A thin spherical shell is of diameter 1.2 m and shell thickness 6 mm. Determine the increase in diameter and increase in volume of the shell when water at 1.2 N/mm² pressure is admitted in it. Take $E=2 \times 10^5$ N/mm² and Poisson ratio=0.3. (10)
8. (a) Write the assumptions made in the Euler's theory.
- (b) Determine the limiting length of a pin ended column of section 60 mm × 100 mm so that the critical stress is 250 N/mm², Assume $E=0.2 \times 10^6$ N/mm². (3+7=10)

UNIT - V
(Compulsory Question)

9. (i) What is Hook's law? How is it applicable in engineering applications?
- (ii) What are thermal strains, how these are developed?
- (iii) What are principal planes and what are the stresses that act on these?
- (iv) What is point of inflexion, where such term is mostly used?
- (v) Define Modulus of rupture and Section modulus?
- (vi) What is neutral axis, does it pass through CG, if yes why?
- (vii) Which shaft is to be preferred amongst hollow and solid one and why?
- (viii) What are the sign conventions associated with deflection of beams?
- (ix) What is hoop stress, how is it related to longitudinal stress in case of thin vessels?
- (x) When is Rankine-Gordon's empirical formula applicable? (2×10=20)