Total No. of Questions : 8]

SEAT No. :

PB3715

[Total No. of Pages : 5

[6261]-124

S.E. (Automobile & Mechanical/Mechanical S.W./Automation & Robotics Engineering)

SOLID MECHANICS

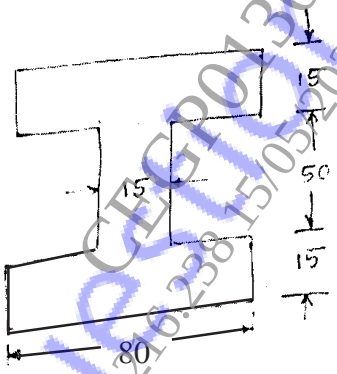
(2019 Pattern) (Semester - III) (202041)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

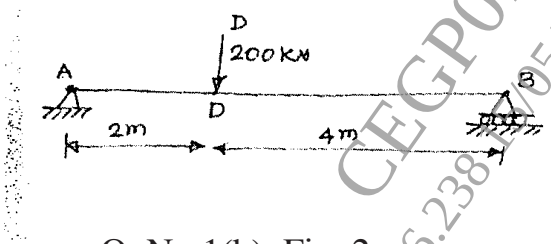
1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
2) *Figures to the right indicate full marks.*
3) *Use Graph Paper for Graphical solution.*
4) *Use of electronic pocket calculator is allowed.*
5) *Assume suitable data if necessary.*

Q1) a) A beam of cross section shown in Fig. 1 is bent about horizontal axis. If a bending moment is 12 kN-m determine the stresses at the top fiber and also at 35 mm from top fiber. Draw bending stress distribution diagram. **[8]**



Q. No 1(a), Fig. 1

b) A horizontal beam as shown in Fig. 2 is hinged at point (A) and supported at roller at point (B) it carries a vertical load of 100kN at Point (D). Determine deflection at point (D) by taking E = 210 GPa, I = 2×10^8 mm^4. **[9]**

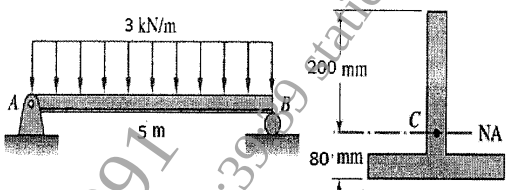


Q. No 1(b), Fig. 2

OR

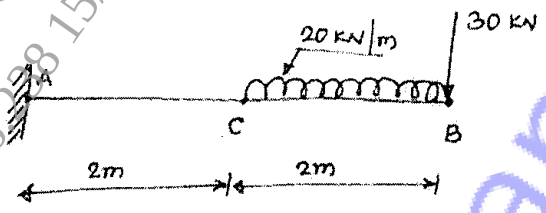
P.T.O.

Q2) a) Determine the maximum tensile and compressive bending stresses in the beam shown in Fig. 3. Take I = 30×10^6mm^4 **[8]**



Q. No 2(a), Fig. 3

b) Calculate slope and deflection at point (B) for a given beam shown in Fig. 4. Take E = 200 GPa and I = 3×10^8mm^4. **[9]**



Q. No 2(b), Fig. 4

Q3) a) A hollow steel rod 300 mm long is to be used as torsional spring. The ratio of inside to outside diameter is 1:2. The required stiffness of this spring is 200 N-m /degree. Determine the outside diameter of the rod. If value of G is 8×10^4 N/mm^2. **[9]**

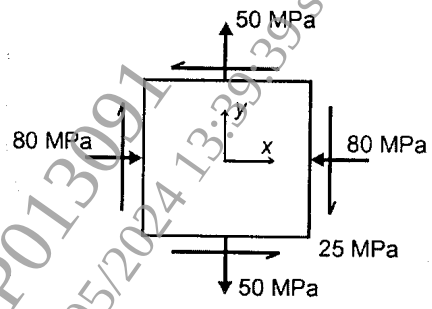
b) A rectangular steel bar 40 mm × 50 mm in cross-section, pinned at each end and subjected to axial compression. The bar is 2 m long and E = 200 GPa. Determine the buckling load using Euler's formula and corresponding stress. **[9]**

OR

Q4) a) Determine the diameter of a solid shaft which will transmit 300 kW at 400 rpm. The maximum shear stress should not exceed 40 N/mm^2 and twist should not be more than 10 in a shaft length of 3 m. The modulus of rigidity of the material is 1×10^5 N/mm^2. **[9]**

b) A hollow cast iron column of 400 mm external diameter and 300 mm internal diameter is used as a column 4 m long with both ends hinged. Determine the safe compressive load the column can carry without buckling using Euler's formula. E = 0.7×10^5 N/mm^2, FOS = 4, Crushing Stress (σ_c) = 500 N/mm^2. **[9]**

Q5) a) The state of plane stress at a point is represented by the stress element shown in Fig. 5. Determine the stresses acting on an element oriented 30º clockwise with respect to the original element. **[9]**



Q. No 5(a), Fig. 5

b) A solid shaft is subjected to bending moment of 20 kN-m and twisting moment 10 kN- m. Find the diameter of the shaft according to **[9]**

1) Maximum distortion energy theory

2) Maximum strain energy theory

Take stress at elastic limit = 210 MPa, Poisson's ratio = 0.3 and Factor of safety = 2.5.

OR

Q6) a) A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 150 MPa in the vertical direction. The point is also subjected to a simple shear stress of 30 MPa, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. What is the magnitude of the normal and shear stresses inclined on a section at an angle of 20° with the major tensile stress. Use Mohr's Circle Method. **[9]**

b) A bolt is subjected to an axial pull of 10 kN & a transverse shear force of 5 kN. Determine the diameter of the bolt required based on. **[9]**

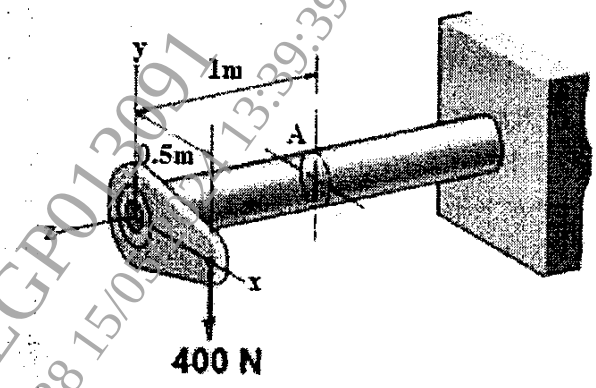
1) Maximum distortion energy theory

2) Maximum shear stress theory

3) Maximum principal stress theory

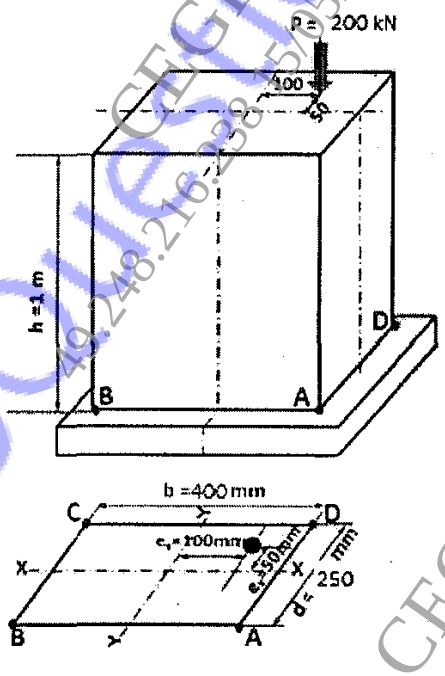
Take elastic limit in simple tension = 200 MPa, Poisson's ratio = 0.2 and Factor of safety = 3.

Q7) a) A 100 mm diameter bar with a built in bracket is fixed to the wall and loaded as shown in Fig. 6. Determine the principal stresses at the top extremity of the vertical diameter for the section marked A. **[8]**



Q. No 7(a), Fig. 6

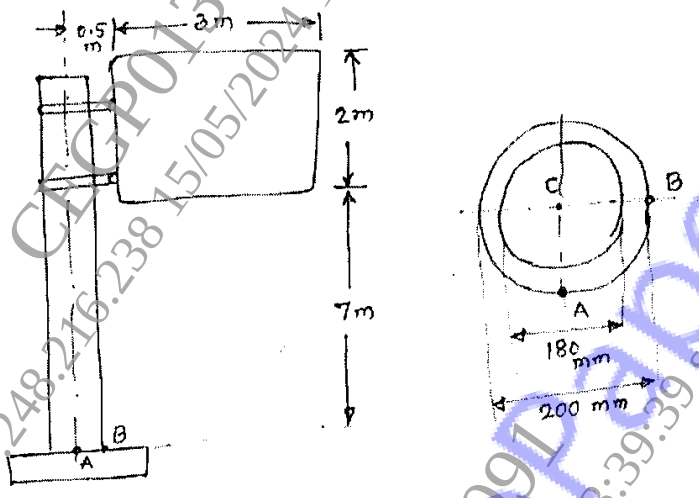
b) A Load of 100 kN load is applied at a point of X = 100mm and Y = 50 mm from X and Y axis as shown in fig. 7 on a short vertical post of rectangular cross section of 400 mm × 250 mm and height 1 m. Determine the stress applied at point A, B, C and D. And its nature of stress. **[9]**



Q. No 7(b), Fig. 7

OR

Q8) A signboard shown in Fig. 8 of dimensions 3.0 m × 2 m is supported by a hollow circular pole having outer diameter 200 mm and inner diameter 180 mm. The sign is offset 0.5 m from the centerline of the pole and its lower edge is 7.0 m above the ground. Determine the principal stresses and maximum shear stresses at points A and B at the base of the pole due to a wind pressure of 4.0 kPa against the signboard. **[17]**



Q. No 8, Fig. 8

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