B. TECH. SEM - III (MECHANICAL ENGG.) (2014 COURSE) (CBCS)
: WINTER - 2017
SUBJECT : SOLID MECHANICS

Day : **Monday**
Date : **15/01/2018**

Time : **10.00 AM TO 01.00 PM**
Max. Marks : 60

W-2017-2047

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use of non-programmable **CALCULATOR** is allowed.
4) Assume suitable data if necessary.

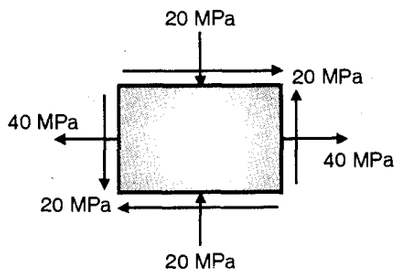
Q.1 A mild steel bar 250 mm long and 100 mm × 100 mm in cross section is subjected to longitudinal axial compressive force of 1000 kN. Determine the values of lateral forces necessary to prevent any transverse strain. Also find change in length and volume. Assume E = 200 GPa and $\mu = 0.3$. **[10]**

OR

A steel tie rod 50 mm in diameter and 2.5 m long is subjected to a pull of 100 kN. To what length the rod should be bored centrally so that the total extension will increase by 15 percent under the same pull, the bore being 25 mm diameter. Take E = 200 GN/m^2.

Q.2 The state of stresses in a strained material is shown in figure. Find analytically **[10]**

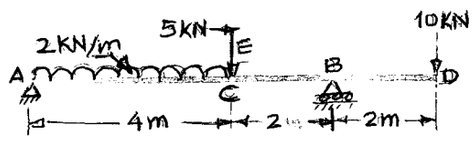
a) Principal planes
b) Principal stresses
c) Normal stress on the planes of maximum and minimum shear stresses.
d) Maximum and minimum shear stresses and their planes.
e) Normal stress, shear stress and the resultant stresses on the planes the normal of which are inclined at +30^0 with x-axis.



OR

Two direct stresses are acting at two mutually perpendicular planes in a material. Both of them are tensile and are 150 N/mm^2 and 80 N/mm^2 respectively. Find the shear stress acting on the planes to consider the materials failure according to maximum principal stress theory, maximum shear stress theory and shear strain energy theory. Take yield stress to be equal to 300 N/mm^2.

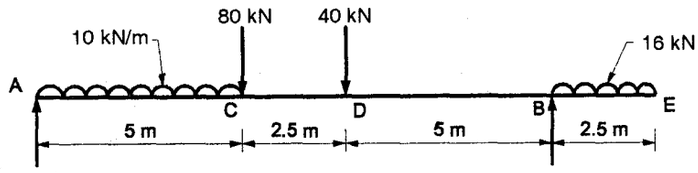
Q.3 Draw the shear force and bending moment diagram for the beam shown in figure. **[10]**



P.T.O.

OR

Draw the S.F.D and B.M.D. for the beam shown in figure. Indicate the numerical values at all important sections. Find the position of contraflexure, magnitude and position of maximum B.M.



Q.4 Determine the diameter of a solid shaft which will transmit 300 kW at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 1^0 in a shaft length of 2m. Take modulus of rigidity = 1×10^5 N/mm^2. **[10]**

OR

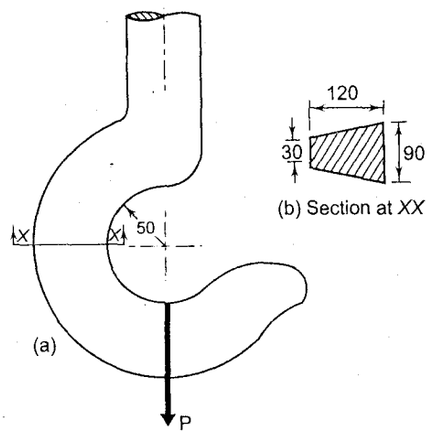
A 3 m cantilever beam is loaded with a point load of 10 kN at its free end. Find the cross – section of the beam. The maximum bending stress is not to exceedd 5N/mm^2 and the maximum deflection is restricted to 8 mm.
Take E = 2×10^4 N/mm^2.

Q.5 A CI beam of C section with top flange 150 mm × 15 mm, bottom flange 200 mm × 20 mm and web 15 mm × 200 mm is supported over a span of 6 m. If the permissible stresses are 120 MPa compression. What udl can be safely applied on beam? What will be tensile stress in the beam? **[10]**

OR

A simply supported T beam has a span of 2 m. The flange is 125 mm × 25 mm and web is 175 mm × 20 mm. The beam carries a UDL of 15 kN/m throughout. Calculate the bending stress and shear stress values for maximum values of BM and SF. Draw neat sketches showing bending stress and shear stress distribution diagram across the section.

Q.6 A crane hook having an approximate trapezoidal cross section is shown in figure. It is made of plain carbon steel 45C$_8$ (Syt = 380 N/mm^2) and the factor of safety is 3.5. Determine the load carrying capacity of the hook. **[10]**



OR

Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420 N/mm^2. The ultimate tensile and shearing strength of the pin material are 510 N/mm^2 and 396 N/mm^2 respectively. Determine the tie rod section and pin section. Take factor of safety = 6.

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