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B.TECH
(SEM V) MODEL PAPER 2023-24
STRENGTH OF MATERIALS

Time: 3Hours   *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTIONA

1.   **Attempt *all* questions in brief.**   **2x10=20**

a.   Explain why stresses induced in the body are more in case of impact load than gradually applied load.

b.   What do you understand by theories of failures? Explain any one theory in brief.

c.   Write the expression for finding stresses due to bending in straight and curved beams.

d.   Write down various assumptions made in simple bending theory.

e.   What is proof load?

f.   What is meant by the term "Volumetric Strain?"

g.   Define shear centre and its importance.

h.   Write the expression for finding stresses due to bending in straight and curved beams

i.   Explain the purpose of compounding thick cylinders.

j.   What is the difference between bending moment and twisting moment?

SECTIONB

2.   **Attempt any *three* of the following:**   **10x3=30**

a.   The resultant stress on a plane at a point in a material under stress is 80 MPa inclined at 30° to the normal to the plane. The normal component of stress on another plane at right angle to the first plane is 60 MPa. Determine
        (i)   The principal stresses and their planes
        (ii)   (ii) The maximum shear stresses and their planes
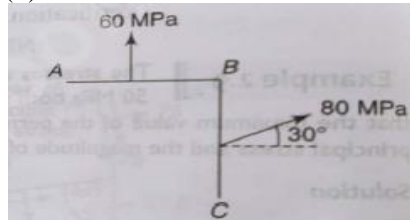
b.   Determine the deflection at a point 1 m from the left end of the beam loaded as shown in figure using Macaulay's method. EI = 0.65 MN m^2.
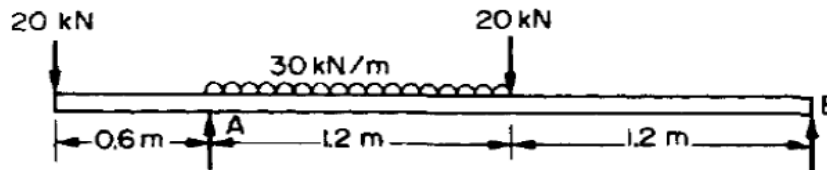

c.   A closed-coiled helical spring having 24 turns is made of 8-mm diameter wire. The mean diameter of the spring is 80 mm, and it carries a load of 250 N. determine the shear stress developed, the deflection and the stiffness of the spring. Take G= 84 GPa.

d.   A cylindrical boiler drum has hemispherical ends .The cylindrical portion is 1.6 m long, 800 mm diameter and 20 mm thick. After filling it with water at atmospheric pressure, it is put on a hydraulic test and the pressure is raised to 12 MPa. Find the additional volume of water required to be filled in the drum at this pressure. Assume the hoop strain at the junction of cylinder and the

hemisphere to be the same for both. Take E = 205 GPa, K = 2080 MPa and Poisson's ratio= 0.3

e. What is Shear Center? Prove that the shear center for a thin walled balanced z direction section coincides with its Centroid.

SECTIONC

3. **Attempt any *one* part of the following:**   **10x1=10**

a. What are the main theories of failure for a material? Explain maximum principal stress theory with its graphical representation.

b. A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and a tensile stress of 47 N/mm^2 on the plane at right angles to the former. Each of the above stresses is accompanied by a shear stress of 63 N/mm2 and that associated with the former tensile stress tends to rotate the block anticlockwise. Find (a) the direction and magnitude of each of the principal stress and (b) magnitude of the greatest shear stress.

4. **Attempt any *one* part of the following:**   **10x1=10**

a. Prove that the maximum shear stress is 3/2 times of the average shear stress in beam of rectangular section subjected to a shear force.

c. A timber joist of 6 m span has to carry a load of 15 kN/m. Find the dimensions of the joist, if the maximum permissible stress is limited to 8 N/mm^2 . The depth of the joist has to be twice the width.

5. **Attempt any *one* part of the following:**   **10x1=10**

a. What assumptions are made in the analysis of columns by Euler's buckling theory? Derive an expression for Euler's crippling load when both ends of column are fixed.

b. An open coil helical spring made from wire of circular cross-section is required to carry a load of 120 N. The wire diameter is 8 mm and mean coil radius is 48 mm. If the helix angle of the spring is 30º and the no. of turns is 12 then find the axial deflection. Take E = 200 GN/m^2 and G = 80 GN/m^2.

6. **Attempt any *one* part of the following:**   **10x1=10**

a. A steel tube of 120-mm external diameter is shrunk on another steel tube of 48-mm internal diameter. After shrinking, the diameter at the junction is 80 mm. Initial difference of diameters at the junction before shrinking was 0.04 mm. Determine:
    (i) Radial pressure at the junction
    (ii) Hoop stress developed in the two tubes after the shrinking.Take E= 210 GPa

b. A compound cylinder is to be made by shrinking one tube on to another so that the radial compressive stress at the junction is 28.5 N/mm^2 . If the outside diameter is 26.5 cm and the bore 12.5 cm, calculate the allowance for shrinkage at the common diameter, which is 20 cm. E = 2.1 × 105 N/mm^2.

7. **Attempt any *one* part of the following:**   **10x1=10**

a. A crane hook is constructed from trapezoidal cross-section material. At the critical section *AB* the dimensions are as shown in Fig. The hook supports a vertical load of 25 kN with a line of action 40 mm from *B* on the inside face. Calculate the values of the stresses at points *A* and *B* taking into account both bending and direct load effects across the section.

50 mm

55 mm

Section at AB

40 mm

25 kN
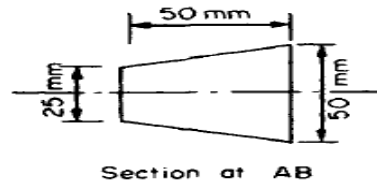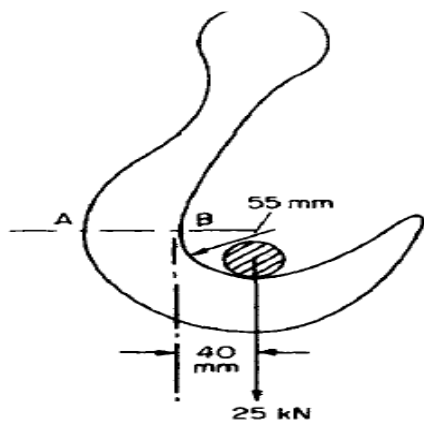
b.   A curved beam, rectangular in cross-section is subjected to pure bending with couple of +40 kN-cm. The beam has width of 2 cm the depth of 4 cm and is curved in a plane parallel to width. The mean radius of curvature is 5 cm. Find the position of the neutral axis, and the ratio of the maximum to the minimum stress.