Pages: 03 **Sub Code: KME-502**

Paper Id: **Roll No.**

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. What do you understand by principal planes and principal axes?
b. Define point of Contraflexure.
c. What is the difference between column and strut?
d. Explain the purpose of compounding thick cylinders.
e. Define shear centre and its importance.
f. What is Winkler-Bach theory?
g. How will you define the strength of column?
h. What are the main assumptions taken to derive the torsion equation?
i. Why are stresses called tensor?
j. How differential equation of elastic curve is used to find slope and deflection of beam?

SECTIONB

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

a. A steel tube with 24 mm external diameter and 18 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If at a temperature of 10 ^{0}C, there is no longitudinal stress, calculate the stresses in the rod and the tube when the temperature is raised to 200 ^{0}C. Take E_s = 2.1 x 10^5 N/mm^2, E_c = 1 x 10^5 N/mm^2, α_s = 11 x 10^{-6} /^{0}C, α_c = 18 x 10^{-6} /^{0}C

b. The T-section having flange of dimension 100 mm x 20 mm and web of dimension 20 mm x 130 mm is subjected to a shear force of 100 kN. Draw the shear stress distribution diagram and find the maximum shear stress.

c. An open coiled helical spring made from wire if circular cross-section is required to carry a load of 100 N. The wire diameter is 8 mm, and the mean coil radius is 40 mm. If the helix angle of the spring is 30^0 and number of turns is 12, calculate (i) axial deflection (ii) angular rotation of free end. Take E = 200 GN/m^2 and G = 82 GN/m^2

d. The maximum stress permitted in a thick cylinder, radii 8 cm and 12 cm, is 20N/mm^2, the external pressure is 6 N/mm^2, what internal pressure can be applied? Plot curves showing the variation of hoop and radial stresses through the material.

e. Why position of neutral axis from centroid for curved beams in Winkler Bach theory is given as

$$y_0 = -\frac{Rh^2}{R^2+h^2}$$

SECTIONC

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

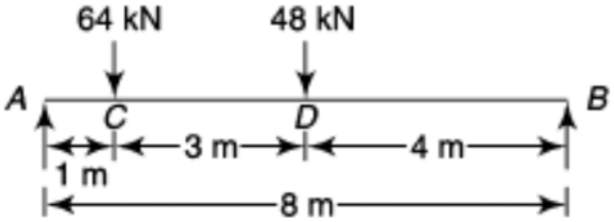
a. **A** load of **2** kN falls through **25** mm on to a stop at the end of a vertical bar 4 m long, *600* mm^2 cross-sectional area and rigidly fixed at its other end. Determine the instantaneous stress and elongation of the bar. E = 200 GN/m^2.

b. In a certain material under load a plane AB carries a tensile direct stress of **30** MN/m2 and a shear stress of 20 MN/m2, while another plane **BC** carries a tensile direct stress of 20 MN/m2 and a shear stress. If the planes are inclined to one another at 300 and plane **AC** at right angles to plane **AB** carries a direct stress unknown in magnitude and nature, find:

(a) The value of the shear stress on **BC;**
(b) The magnitude and nature of the direct stress on AC;
(c) The principal stresses

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

a. A simply supported beam of 8-m length carries two point loads of 64 KN and 48 KN at 1m and 4 m respectively from the left hand end. Find the deflection under each load and the maximum deflection. Take E=210 GPa and I = 180 X 10^6 mm^4.



b. Compare the resistance to torsion of a hollow shaft to that of a solid shaft if the inside diameter of the hollow shaft is two-third of the external diameter and the two shafts have the same material and weight and of equal length.

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

a. Derive an expression for axial elongation and maximum shear stress for a Closed coiled helical spring, taking all the necessary assumption into account. Also discuss Wahl's correction factor.

b. An open coiled helical spring has 12 turns wound to a mean diameter of 100 mm. The angle of the coils with a plane perpendicular to the axis of the coil is 300. The wire diameter is 8 mm. Determine (i) The axial extension with a load of 80 N (ii) The angle turned by the free end if free to rotate. E = 205 MPa and G = 80 GPa.

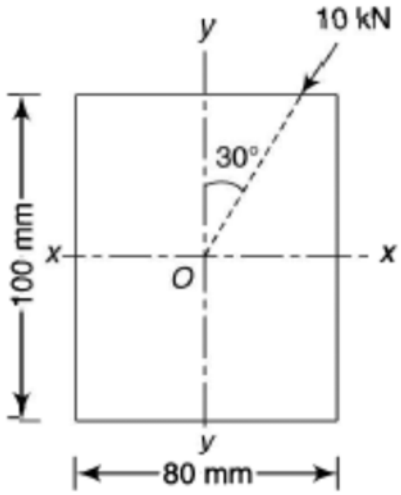
6. Attempt any *one* part of the following: 10x1=10

a. Derive Lame' Equation for thick cylindrical shell(with neat sketch).Also write assumptions in deriving the equation.

b. A cylindrical shell is 3 m long, 1.5 m internal diameter and 20 mm metal thickness. Calculate the intensity of maximum shear stress induced and the change in dimensions of the shell and change in volume the shell if it is subjected to an internal pressure of 2 N/mm2. Take E = 2 x 105 N/mm2 and μ =0.3.

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

a. A 5 meter long simply supported beam of 90 mm width and 110 mm depth carries a load of 15KN at the mid span. The load is inclined at 30^0 to the vertical longitudinal plane and the line of action of the load passes through the Centroid of the rectangular section of the beam. Determine the stresses at all the corners of the section.



b. I section carries 40 kN m bending moment inclined at 180 to the x-axis determine the position of neutral axis from the x axis and the maximum bending stress acting on the section. Properties of the section:
Ixx = 48.9 x 106 mm4, Iyy = 4.73 x 106 mm4
Zxx = 379 x 103 mm3, Zyy = 64.7 x 103 mm3