Subject Code: KME502

PAPER ID-411038

Roll No:

BTECH
(SEM-V) THEORY EXAMINATION 2021-22
STRENGTH OF MATERIALS

Time: 3 Hours ***Total Marks: 100***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Draw Mohr's circle for pure shear in a two-dimensional stress field.
b. Why are stresses called tensor?
c. How differential equation of elastic curve is used to find slope and deflection of beam?
d. Explain section modulus and its significance.
e. What are the types and basic functions of springs?
f. Explain slenderness ratio and its importance in the classification of columns.
g. Derive the expression for finding circumferential stress in a thin cylinder subjected to internal fluid pressure.
h. Explain the purpose of compounding thick cylinders.
i. Write the expression for finding stresses due to bending in straight and curved beams
j. Differentiate between pure and unsymmetrical bending.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. At a point in a beam the normal stress along the length is 80 N/mm^2. The shear stress at that point is positive (CW) of magnitude 35 N/mm^2. Find the stresses on a plane whose normal is inclined at 30^0 to the longitudinal axis. Also find the principal stresses and planes on which they act.
b. A simply supported beam of span 10 m carries a uniformly distributed load of 40 kN/m over a length 5 m of its left half and a concentrated load of 80 kN at 7.5 m from the left end. Determine the slopes at the ends, and the deflections under the concentrated load and at mid-span. Take E = 2 x 10^6 kN/m^2 and I = 56,000 cm^4.
c. Derive the expression for the critical buckling for a column having one end fixed and the other end free.
d. The maximum stress permitted in a thick cylinder, radii 8 cm and 12 cm, is 20 N/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. Explain the following:
   (i) Why is the knowledge of shear center of a beams being important?
   (ii) Why position of neutral axis from centroid for curved beams in Winkler Bach theory is given as

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

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) At a point in a steel member, the major principal stress is 200 N/mm^2, find the minor principal stress which is compressive. If the tensile yield stress is 250 N/mm^2 at which yielding commence, using
   (i) Maximum strain energy (Haigh) theory
   (ii) Maximum shear strain energy (Von Mises) theory

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(b) 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 $E_s = 2.1 \times 10^5$ N/mm^2, $E_c = 1 \times 10^5$ N/mm^2, $\alpha_s = 11 \times 10^{-6}$ /^{0}C, $\alpha_c = 18 \times 10^{-6}$ /^{0}C

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) A flitched timber consists of two joists each 80 mm wide and 240 mm deep, with a steel plate 160 mm deep and 12 mm thick placed symmetrically between and clamped to them. Calculate the total moment of resistance of the section if the allowable stress in joist is 9 N/mm^2 take $E_s = 20\ E_t$

(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.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) 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

(b) An I section 300 mm x 150 mm is provided with a flange plate 200 mm x 12 mm for each flange. The I section used as a strut with one end fixed and other end hinged. Calculate the length of the member for which the crippling load by Rankine and Euler formula will be same. Take $E = 2.1 \times 10^5$ N/mm^2, $\sigma_c = 330$ N/mm^2, $\alpha = \frac{1}{7500}$

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) 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/mm^2. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$.

(b) Derive the Lame's equations to find the stresses in thick cylinders subjected to internal pressure.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) A curved beam of trapezoidal cross-section with widths as 40 mm and 30 mm, depth 50 mm is subjected to pure bending moment of 1500 Nm which try to increase the curvature. Find the bending stress at outermost and innermost fibres. Also plot the variation of bending stresses across the section.

(b) I section carries 40 kNm bending moment inclined at 18^0 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:

$I_{xx} = 48.9 \times 10^6$ mm^4, $I_{yy} = 4.73 \times 10^6$ mm^4

$Z_{xx} = 379 \times 10^3$ mm^3, $Z_{yy} = 64.7 \times 10^3$ mm^3