Sub Code:RME303

Paper Id: 140326 Roll No: | | | | | | | | | | | | | |

B. TECH
(SEM III) THEORY EXAMINATION 2019-20
MECHANICS OF SOLIDS

Time: 3 Hours ***Total Marks: 70***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. What do you understand by Three dimensional state of stress and strain
b. What is meant by the term "Volumetric Strain"
c. Define Poisson's Ratio
d. State the theory of simple bending
e. Why hollow circular shafts are preferred when compared to solid circular shafts?
f. Distinguish between closed and open coiled helical springs.
g. Define slenderness ratio.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Write short notes on: Compatibility equations &-Three-dimensional stress.

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/mm^2 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.

c. A steel column 4m long with both ends fixed what should be the minimum length of the column for Euler's formula to be applicable? Find load carrying capacity of the column. E=200 GPa, σ_{PL}=200 MPa, σ_Y=250 MPa, k_x=180mm k_y=30mm, I_{yy}=834*10^4 mm^4 and A=9272 mm^2.

d. From the first principle derive the expression for critical buckling of a column having both end fixed.
e. Derive the expression for deflection and angular rotation when open coil helical spring is subjected to axial load.

SECTION C

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

(a) A compound steel tube is composed of a tube 200mm internal diameter and 30 mm thickness shrunk on a tube of 200mm external diameter and 25mm thickness. The radial pressure of the junction is 12N/mm^2. The composed tube is subjected to an internal fluid pressure of 80N/mm^2.Find the variation of hoop stress over the wall of compound tube.

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(b) A cantilever type laminated spring (quarter elliptical) has a span of 0.5 m .If each leaf be 8 mm thick and 72 mm wide, Find the number of leaves, so that the spring deflects 60 mm under an end load of 3 kN .Determine maximum bending stress at this load. Also determine the height from which this load may be allowed to fall so that maximum bending stress end used is 700 N/mm^2.Take $E=2x10^5 N/mm^2$.

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

(a) 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. $E = 2.1 \times 10^5$ N/mm^2 .

(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.

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

(a) What is the difference between thick and thin cylinder. State the assumptions made in the analysis of stress in thick cylinders. Derive Lame's equations to find the stresses in thick cylinders

(b) 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.

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

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

(b) A steel shaft is subjected to an end thrust producing a stress of 90 MPa and the maximum shear stress on the surface arising from the torsion is 60 MPa. The yield point of the material in simple tension was found to be 300 MPa. Calculate the F.O.S. of the shaft according to maximum shear stress and maximum distortion energy theory

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

(a) Derive Winkler batch formula for bars with large initial curvature.

(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 30° and the no. of turns is 12 then find the axial deflection. Take E = 200 GN/m^2 and G = 80 GN/m^2 .