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Paper Id: 233671 **Roll No.** | | | | | | | | | | |

B.TECH
(SEM III) THEORY EXAMINATION 2022-23
MECHANICS OF SOLIDS

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

Note: 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 is compound stress and strain?
(b) Define Hook's law.
(c) What do you understand by principle planes and principle axes?
(d) Distinguish between closed and open coiled helical springs
(e) Define slenderness ratio and equivalent length.
(f) What is the criteria for deciding whether it is a thick cylinder or thin cylinder?
(g) What do you understand by torsional rigidity and angle of twist?

SECTION B

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

(a) A compound bar 90 cm long is made of a rod of steel 30 cm long 3 cm diameter securely fastened to a rod of copper 60 cm long. Under a pull of 50 KN the extensions in each portion are found to be equal. What is (a) the diameter of copper rod, (b) stresses in steel and copper (c) the work done in extending the compound bar? Es = 205,000 N/mm^2, Ec = 110,000 N/mm^2.

(b) A hollow steel shaft 10 cm external diameter, 5 cm internal diameter, transmits 600 KN at 500 rpm and is subjected to an end thrust of 60 KN. Find what bending moment may be safely applied to the shaft if the greater principle stress is not to exceed 100 N/mm 2 .

(c) A solid round bar 60 mm in diameter and 2.5 m long is used as a strut. One end of the strut is fixed, while its other end is hinged. Find the safe compressive load for this strut, using Euler's formula. E=200GPa and factor of safety=3

(d) A compound cylinder made by shrinking a cylinder of external diameter 300mm and internal diameter of 250mm over another of external diameter of 250 mm and internal diameter of 200mm. The radial pressure at the junction after shrinking is 8 N/mm2.find the final stresses set up across the section, when the compound cylinder is subjected to an internal pressure of 84.5N/mm2.

(e) Derive the equation to find the position of neutral axis for the following cross section of curved beam:
(i) Rectangular section
(ii) Trapezoidal cross section

SECTION C

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

(a) In a stressed body, at a point on two perpendicular planes, normal stresses are 100 Mpa and 60 Mpa and the shear stress act on these planes. If the maximum principle stress at a point is 136 Mpa, what is the magnitude of shear stress? Also calculate the maximum shear stress and maximum shear stress at that point.

(b) Explain the theories of failurewith their application.

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

(a) Derive the differential equation of deflection curve

(b) Find the reaction at supports of a continuous beam ABC when span length AB= 4m and BC= 4m. The span AB carries a point load of 20 KN at a distance of 1m from support A and the span BC carries a uniformly distributed load having intensity of 8 KN/m.

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

(a) Compare the crippling loads given by Rankine's and Euler's formulae for tubular strut 2.25m long having outer and inner diameters of 37.5mm and 32.5mm loaded through pin joint at both end. Take Yield stress as 315 MPa. a = 1/7500 and E= 200GPa.If the elastic limit for the material is taken as 200MPa, then for what length of the strut does the Euler's formulae apply?

(b) Derive the expression of crippling load for a column having both end fixed.

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

(a) A thin cylinder 150 mm internal diameter, 2.5 mm thick, has its end closed by rigid planes and then filled with water. When an external axial pull of 37 KN is applied to its ends the water pressure is observed to fall by 0.1 N/mm 2. Determine the value of poison's ratio. E= 1.4 x 10^5 N/mm^2, K= 2200 N/mm^2.

(b) 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

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

(a) Derive the equation to find the position of neutral axis for the following cross section of curved beam:
   (i) Rectangular section
   (ii) Trapezoidal cross section

(b) A 40 mm x 40mm x 5 mm angle is used as a simply supported beam over a span of 2.4 m. It carries a load of 200 N along the vertical axis passing through the centroid of the section. Determine the resulting bending stresses on the corners of the section, along the middle section of the beam.