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B TECH
(SEM-III) THEORY EXAMINATION 2020-21
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.	Define Poisson's ratio.
b.	A wooden tie is 7.5 cm wide, 15 cm deep and 1.5 m long. It is subjected to an axial pull of 4500 kg. The stretch of the member is found to be 0.0638 cm. Find the value of Young's Modulus for the tie material.
c.	Define section modulus.
d.	What do you mean by slenderness ratio?
e.	In case of a seamless shell write the formula for change in volume, change in length and change in diameter.
f.	A simply supported beam of span L is carrying a uniformly distributed load of W per unit run over the whole span. The maximum deflection in this case is given as.
g.	What is Shear center?

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

a.	A shaft is subjected to a maximum torque of 10 kNm and a maximum bending moment of 7.5 kNm at a particular section. If the allowable equivalent stress in simple tension is 160 MN/m ² , find the diameter of the shaft according to the maximum shear stress theory.
b.	From the first principles derive the expression for the critical buckling for a column having both the end fixed.
c.	A steel girder of uniform section, 14 meter long is simply supported at its ends. It carries concentrated load of 90 kN and 60 kN at two points 3 m and 4.5 m from the two ends respectively. Calculate the deflection under the two loads and maximum deflection. $I=64 \times 10^{-4} \text{ m}^4$, $E= 210 \times 10^6 \text{ KN/m}^2$.
d.	Derive Lamé's equation for thick cylinder, when internal pressure is P_1 and external pressure is zero.
e.	Determine the position of neutral axis, and maximum and minimum stresses when a curved beam of circular section of diameter 100 mm is subjected to pure bending moment of + 11.5 kNm. The radius of curvature is 100 mm.

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

(a)	A point in a strained material is subjected to stress as shown in fig.1. Locate the principal plane and evaluate the principal stress.
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(b)	Discuss theories of failure in detail.

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

(a)	Find the internal and external diameters required for a hollow shaft, which is to transmit 40 kW of power at 240 rpm. The shear stress is to be limited to 100 MN/m ² . Take outside diameter to be twice the inside diameter.
(b)	A timber beam 10 cm wide and 15 cm deep supports a uniformly distributed load over a span of 2 meters. If the safe stresses are 280 kg/cm ² longitudinally and 20 kg/cm ² in transverse shear, calculate the maximum load which can be supported by the beam.

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

(a)	A closely coiled helical spring is to carry a load of 500 N. Its mean coil diameter is to be 10 times that of wire diameter. Calculate the mean diameter if the maximum shear stress in the material of the spring is to be 80 MPa. If the stiffness of the spring is 20 N per mm deflection and modulus of rigidity is 86000 MPa. Find the number of coils in the closely coiled helical spring.
(b)	Explain the middle third rule for rectangular section. Also write the limitation of Euler's formula for critical load.

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

(a)	Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when a pipe contains a fluid at a pressure of 8 N/mm ² . Also sketch the radial pressure distribution and hoop stress distribution across the section.
(b)	A boiler drum consists of a cylindrical portion 4 m long, 1.5 m in diameter and 2.25 thick. It is closed by hemispherical ends. In a hydraulic test to 6 MN/m ² , how much additional water will be pumped in after initial filling at atmospheric pressure? The circumferential strain at the junction of the cylinder and hemisphere may be assumed as same for both. $E = 200 \text{ GN/m}^2$, $K \text{ (for water)} = 2.13 \text{ GN/m}^2$, $1/m = 0.3$

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

(a)	Prove the formula for the position of shear centre for channel section.
(b)	Find the expression for h^2 for circular section.