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**BTECH**  
**(SEM III) THEORY EXAMINATION 2023-24**  
**MECHANICS OF SOLIDS**

TIME: 3HRS

M.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 the term elasticity, modulus of elasticity.
b.	Define resilience, proof resilience and modulus of resilience
c.	Define section modulus.
d.	What do you mean by slenderness ratio?
e.	Differentiate between a thin cylinder and thick cylinder
f.	State the assumptions made in Euler's column theory
g.	What do you mean by shear center.

**SECTION B**

**2. Attempt any three of the following:**

**7 x 3 = 21**

a.	Derive the expression for strain energy stored when load is applied suddenly. A rod 12.5mm in diameter is stretched 3.2mm under a steady load of 10N. What stress would be produced in the bar by a weight of 700N, falling through 75mm before commencing to stretch, the rod being initially unstressed? $E$ is $2.1 \times 10^5$ N/mm <sup>2</sup> .
b.	Discuss the theories of failure in detail.
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. $I = 64 \times 10^4$ m <sup>4</sup> , $E = 210 \times 10^6$ KN/m <sup>2</sup> .
d.	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 <sup>2</sup> . Take outside diameter to be twice the inside diameter.
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)	The principal stresses at a point in a bar 100 N/mm <sup>2</sup> (T) and 75 N/mm <sup>2</sup> (T). Each of the above stress is accompanied by a shear stress of 75 N/mm <sup>2</sup> . Determine the normal, shear and resultant stresses on an oblique plain inclined at an angle of 45° with the axis of minor tensile stress with the help of Mohr's circle.
(b)	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 <sup>2</sup> , find the diameter of the shaft according to the maximum shear stress theory.

**4. Attempt any one part of the following:**

**7 x 1 = 7**

(a)	Using Macaulay's method, derive the expression for the deflection and slope in case of simply supported beam with an eccentric point load.
(b)	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 <sup>2</sup> . Take outside diameter to be twice the inside diameter.

**5. Attempt any one part of the following:**

**7 x 1 = 7**



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(a)	Derive the expression for stiffness of helical closed coil springs, under axial load.
(b)	Find the expression for crippling load for a long column when one end of the column is fixed and other end is hinged.

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

(a)	In case of a seamless shell write the formula for change in volume, change in length and change in diameter.
(b)	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 <sup>2</sup> . Also sketch the radial pressure distribution and hoop stress distribution across the section.

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

(a)	State the assumption made in the analysis of stress in thick cylinder. Derive lame's equation to find the stresses in thick cylinder.
(b)	<p>A simply supported I section beam of span 2m carrying concentrated load of 4 kN at an angle of 20° from vertical as shown in fig. the load passes through CG of the section. Determine the maximum and minimum bending stresses in the beam.</p> 