Roll No: | | | | | | | | | | | | | |

BTECH
(SEM III) THEORY EXAMINATION 2021-22
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.	Explain the terms section modulus and write the expression for the same.
b.	Explain Hook's Law in brief.
c.	Analytically differentiate between bending of straight and curved beam.
d.	Define shear stresses in beam and its importance.
e.	Explain slenderness ratio and its relation with stress
f.	Differentiate between strain energy and shear strain energy.
g.	What are the various stresses acting on closed and open coiled springs?

SECTION B

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

a.	Derive the equation for principal stresses and principal planes for an element subjected to compound stresses.
b.	A closely-coiled helical spring of round steel wire 5 mm in diameter having 12 complete coils of 50 mm mean diameter is subjected to an axial load of 100 N. Find the deflection of the spring and the maximum shearing stress in the material. Modulus of rigidity (C) = 80 GPa
c.	A cylindrical shell of 500 mm diameter is required to withstand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 MPa and efficiency of the joints is 65%. Take factor of safety as 5
d.	A cantilever beam is rectangular in section having 80 mm width and 120 mm depth. If the cantilever is subjected to a point load of 6 kN at the free end and the bending stress is not to exceed 40 MPa, find the span of the cantilever beam.
e.	Derive the differential equation of deflection curve.

SECTION C

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

(a)	In an elastic material, the direct stresses of 120 MN/m^2 and 90 MN/m^2 are applied at a certain point on planes at right angles to each other in tension and compressive respectively. Estimate the shear stress to which material could be subjected, if the maximum principal stress is 150 MN/m^2. Also find the magnitude of other principal stress and its inclination to 120 MN/m^2.
(b)	The state of stress at a point in a loaded component principal stresses is found to be as given below: σ_x =50 GN/m^2; σ_y =150 GN/m^2; τ_{xy} =100 GN/m^2; Determine the principal stresses and maximum shearing stress. Find the orientations of the planes on which they act.

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

(a)	A solid circular shaft transmits 75kW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1º in 2m length and the shear strength is limited to 50 MN/m^2. Take G = 100GN/m^2.

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(b)	A steel bar 10 cm wide and 8 mm thick is subjected to bending moment. The radius of neutral surface is 100 cm. Determine maximum and minimum bending stress in the beam.

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

(a)	An open coil helical spring made up of 10 mm diameter wire and of mean diameter of 100 mm has 12 coils, angle of helix being 15°. Determine the axial deflection and the intensities of bending and shear stresses under an axial load of 500 N. Take C as 80 GPa and E as 200 GPa
(b)	An I section joist 400 mm × 200 mm × 20 mm and 6 m long is used as a strut with both ends fixed. What is Euler's crippling load for the column? Take Young's modulus for the joist as 200 GPa

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

(a)	A cylindrical vessel 2 m long and 500 mm in diameter with 10 mm thick plates is subjected to an internal pressure of 3 MPa. Calculate the change in volume of the vessel. Take E = 200 GPa and Poisson's ratio = 0.3 for the vessel material.
(b)	A thick metallic cylindrical shell of 150 mm internal diameter is required to withstand an internal pressure of 8 N/mm^2. Find the necessary thickness of the shell, if the permissible tensile stress in the section is 20 N/mm^2

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

(a)	A steel bar 50 mm in diameter, is formed into a circular arc of 4 m radius and supports an angle of 90o. A couple is applied at each end of the bar, which changes the slope to 95o at one end relative to the other. Calculate the maximum bending stress due to the couple. Take E as 200GPa
(b)	Two wooden planks 150 mm × 50 mm each are connected to form a T-section of a beam. If a moment of 6.4 kN-m is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the bending stresses at both the extreme fibres of the cross- section