PAPER ID-312084

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BTECH
(SEM III) THEORY EXAMINATION 2024-25
MECHANICS OF SOLIDS

TIME: 3 HRS **M.MARKS: 70**

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

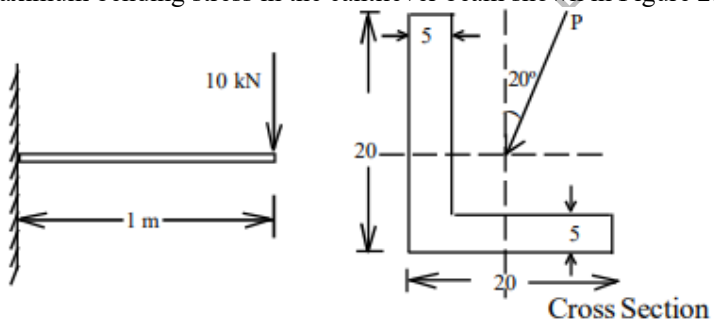
SECTION A

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

a.	Why are stresses called tensor?
b.	Define Proof resilience and modulus of resilience.
c.	Write the relation for axial deflection for open coil helical spring to axial load.
d.	Describe compound cylinders?
e.	Why Shear Center is also called the center of twist?
f.	What do you mean by 'strength of a shaft'? Also Explain flexural rigidity.
g.	Why spherical containers are more preferred to store the gases in comparison to cylindrical containers.

SECTION B

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

a.	An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and the greatest shear stress.
b.	Derive the bending question and write the assumption.
c.	A closed coil helical spring made of 8 mm diameter has 12 coils of 150 mm mean diameter. Calculate the elongation, torsional stress and strain energy per unit volume when the spring is subjected to an axial load of 120 kN. Take modulus of rigidity as 80 GPa. If a torque of 9 kN-m is applied in place of axial load, find axial twist, bending stress and strain energy per unit volume. Take modulus of elasticity as 200 GPa.
d.	How thick and thin cylinder are classified? Derive Lame's equation for the Hoop stress and radial stress in thick cylinder.
e.	Find the maximum bending stress in the cantilever beam shown in Figure 2.  **Figure 1**

SECTION C

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

(a)	The load on a bolt consists of an axial pull of 15 kN together with a transverse shear of 7.5 kN. Determine the diameter of bolt according to 1) Maximum strain theory 2) Shear strain energy theory. Given that elastic limit in tension is 285 N/mm^2 and a FOS of 3 is to be applied. Take μ= 0.3
(b)	Derive an expression for 1) Stress due to Gradually applied load. 2) Stress due to Suddenly applied load. 3) Stress due to impact load.

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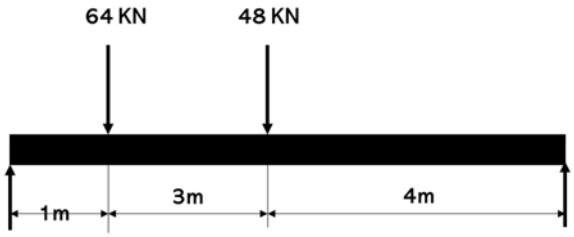
4. Attempt any *one* part of the following: 7 x 1 = 7

(a)	A cast iron water pipe of 500 mm inside diameter & 20 mm thick is supported over a span of 10 meter. Determine the maximum stress in the pipe material when the pipe is running full. Take density of cast iron as 70.6 KN/m^3 & that of water as 9.8 KN/m^3.
(b)	A simply supported beam of 8-m length carries two-point loads of 64 KN. and 48 KN at 1m and 4 m respectively from the left-hand end. Find the deflection under each load and the maximum deflection. Take E=210 GPa and I = 180 X 10^6 mm^4.  **Figure 2**

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

(a)	Find the expression for crippling load for a long column when one end of the column is fixed, and another end is free. Also derive the Rankine formula.
(b)	A leaf spring has 12 plates each 50 mm wide and 5 mm thick, the longest plate being 600 mm long. The greatest bending stress is not to exceed 180 N/mm^2 and the central deflection is 15 mm. Calculate the magnitude of the greatest central load that can be applied to the spring. E=0.206MN/mm^2.

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

(a)	The maximum stress permitted in a thick cylinder, radius 8 cm & 12 cm is 20 N/mm^2, the external pressure is 6N/mm^2, what internal pressure can be applied? Plot curves showing the variation of hoop & radial stress.
(b)	Wall thickness of a cylindrical shell of 800 mm internal diameter is 10 mm. Length of the cylinder is 2 m. if the shell is subjected to an internal pressure of 1.5 Mpa. Determine maximum shear stress induced and change in dimensions of the shell. E= 200 GPa and μ=0.3.

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

(a)	Derive an expression for neutral axis of curved beam: a) Rectangular Section b) Circular Section
(b)	A curved bar of square section 3 cm sides and mean radius of curvature 4.5 cm is initially unstressed. If a bending moment of 300 N-m is applied to the bar tending to straighten it, find the stresses at the inner and outer faces.