BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BARCH **SEMESTER : III**
BRANCH: ARCHITECTURE **SESSION : MO/2025**

SUBJECT: AR204 STRUCTURAL MECHANICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	For the state of stress σ_x = 21 MPa, σ_y = 11 MPa, and τ_{xy} = 8 MPa, draw the Mohr's circle. Determine the principal stresses and maximum shear stress.	[5]	1	3
Q.1(b)	Explain the working of a strain gauge along with a 45° strain rosette.	[5]	1	2
Q.2(a)	Illustrate and explain with examples how bending and shear stresses are formed in beams.	[5]	1, 2	2
Q.2(b)	A simply supported wood beam of rectangular cross section and span length 1.2 m carries a concentrated load P at mid span as shown in Figure 1. The cross section has width 140 mm and height 240 mm. Calculate the maximum permissible value of the load P If the allowable bending stress is 8.5 MPa.	[5]	1, 2, 3	3

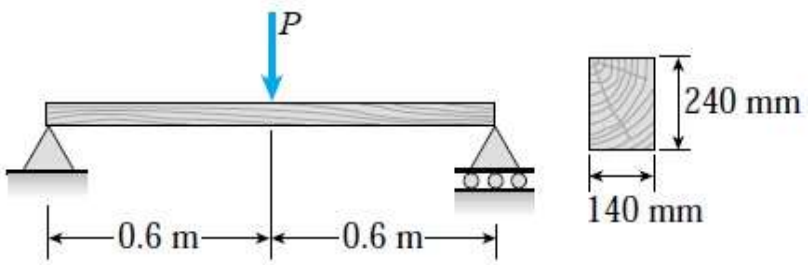

Figure 1.

Q.3(a)	Use the double integration method to find out the slope (at the ends) and deflection (mid-point) of a simply supported beam with uniformly distributed load.	[5]	1, 2, 3	3
Q.3(b)	A simply supported beam (Figure 2) of length *l* carried a uniformly distributed load of intensity *w* starting from a distance *l/4* from the left end and ending at the mid-span. Deduce the expression for slope and deflection at any point. Use Macaulay's method.	[5]	1, 2, 3	3, 4

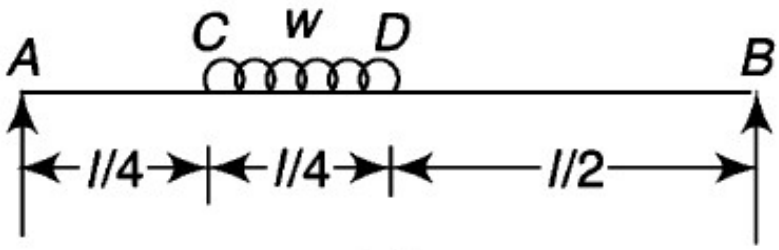

Figure 2.

PTO

Q.4(a)	Explain modulus of resilience and modulus of toughness. Also show them on the stress strain diagram. A bar 1 m in length is subjected to a pull such that maximum stress is equal to 150 N/mm^2. The cross section is 200 mm^2 over a length of 950 mm. For the middle 50 mm length the cross-sectional area is 100 mm^2. If $E = 2 \times 10^5$ N/mm^2, calculate the strain energy stored in the bar.	[5]	1, 2, 3	2, 3
Q.4(b)	A cantilever beam AB is subjected to three different loading conditions: (a) a concentrated load P at its free end, (b) a couple M_o at its free end, and (c) both loads acting simultaneously at the free end. For each loading condition, determine the strain energy of the beam.	[5]	1, 2, 3, 4	4
Q.5(a)	Outline the assumptions followed to derive the Euler's formula for buckling of columns.	[5]	1, 2	3
Q.5(b)	A steel bar of rectangular section 30 mm × 40 mm pinned at each end is subjected to axial compression. The bar is 1.75 m long. Determine the buckling load and corresponding axial stress using Euler's formula. Determine the minimum length for which Euler's equation may be used to determine the buckling load if the proportional limit of the material is 200 N/mm^2. Take $E = 2 \times 10^5$ N/mm^2.	[5]	1, 2, 3, 5	3

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