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

CLASS: BTECH **SEMESTER : V/ADD**
BRANCH: MECH **SESSION : MO/2025**

SUBJECT: ME355 ADVANCED SOLID MECHANICS

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1	The state of stress at a point is such that $$[\sigma_{ij}] = \begin{bmatrix} 0 & -75 & -55 \\ -75 & 0 & 65 \\ -55 & 65 & 0 \end{bmatrix} MPa$$ Determine the principal stresses and their directions.	[5]	1	4
Q.2	Explain what is meant by octahedral stresses and their significance in stress analysis. Derive the expressions for octahedral normal stress and octahedral shear stress in terms of principal stresses.	[5]	1	2
Q.3	Consider the displacement field: $u = [y^2 i + 3yzj + (4 + 6x^2)k]10^{-2}$. What are the rectangular strain components at point P (1, 0, 2)? Use only linear terms.	[5]	1	4
Q.4	Explain the behavior of a beam-column subjected to axial and lateral loads. Discuss why the principle of superposition does not directly apply in this case and write down the governing differential equation for beam-column deflection.	[5]	2	2
Q.5	A simply supported pin-ended column of length L, modulus of elasticity E and moment of inertia I is subjected to an axial compressive load P. Assume the buckled shape of the column is given by $$y(x) = a\sin(\pi x/L)$$ Where a is an unknown parameter. Using the Rayleigh–Ritz method and the minimum total energy principle: i. Find expressions for the elastic strain energy U_b due to buckling of the column and potential energy U_p due to the applied compressive load P using $y(x)$. ii. Find the expression for the total potential energy $U_b + U_p$. iii. Determine the critical load P_{cr} for buckling.	[5]	2	3

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