

CLASS: BTECH  
BRANCH: MECHANICAL

SEMESTER : V  
SESSION : MO/2024

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

- |     |  |     |         |         |
|-----|--|-----|---------|---------|
| Q.1 | For the given state of stress, determine the principal stresses and their directions | [5] | CO<br>1 | BL<br>3 |
|-----|--|-----|---------|---------|

$$[\sigma] = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}.$$

- |     |   |     |   |   |
|-----|---|-----|---|---|
| Q.2 | The displacement field in suitable units for a body is given by | [5] | 1 | 3 |
|-----|---|-----|---|---|

$$\vec{u} = (x^2 + y)\hat{i} + (3 + z)\hat{j} + (x^2 + 2y)\hat{k}$$

Determine the principal strains at (3, -1, 2) and the direction of minimum principal strain.

- |     |  |       |   |   |
|-----|--|-------|---|---|
| Q.3 | Express all boundary conditions for each of the problems illustrated in the figures below. | [3+2] | 1 | 2 |
|-----|--|-------|---|---|

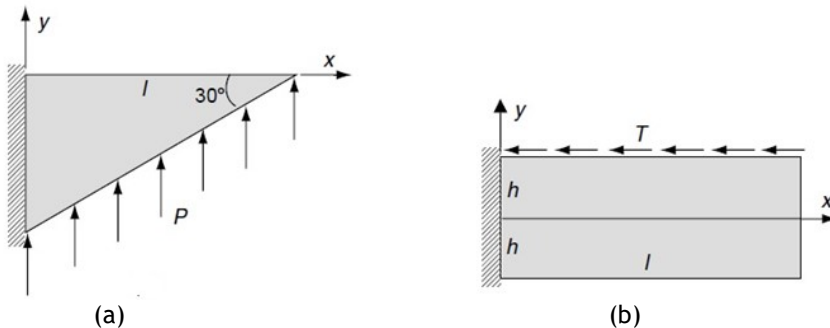


Figure 1

- |     |  |     |   |   |
|-----|--|-----|---|---|
| Q.4 | A beam-column AB is subjected to an axial load $P$ and moments $M_a$ and $M_b$ at supports A and B, respectively as shown in Figure 2. Derive the expression of deflection curve of the beam column. | [5] | 2 | 6 |
|-----|--|-----|---|---|



Figure 2

- |     |  |     |   |   |
|-----|--|-----|---|---|
| Q.5 | Consider a pin-ended column subjected to an axial compressive load $P$ . Assume that the buckled shape of the column is given by | [5] | 2 | 3 |
|-----|--|-----|---|---|

$$y = a \sin \frac{\pi x}{L}$$

where  $a$  is an unknown parameter. Using the energy method, determine the critical load.