

**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.
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|--|-----------------|-----------------|
| <p>Q.1(a) At a point P in a body, <math>\sigma_x = 10,000 \text{ N/cm}^2</math>, <math>\sigma_y = \sigma_z = -5,000 \text{ N/cm}^2</math>, <math>\tau_{xy} = \tau_{yz} = \tau_{zx} = 10,000 \text{ N/cm}^2</math>. Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes. [5]</p> <p>Q.1(b) Illustrate all the boundary conditions for the problem mentioned in Figure 1 below. [5]</p> | <p>CO<br/>1</p> | <p>BL<br/>3</p> |
|--|-----------------|-----------------|

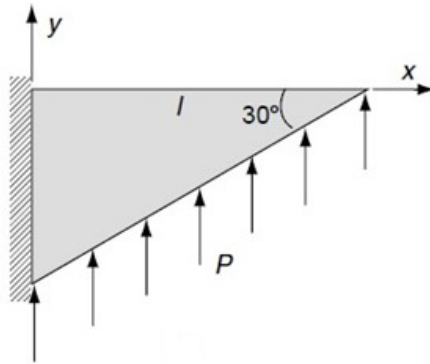


Figure 1

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|--|----------|----------|
| <p>Q.2(a) A beam-column AB is subjected to an axial load P and a transverse load Q as shown in Figure 2. Derive the expression of deflection curve of the beam column. [5]</p> | <p>2</p> | <p>6</p> |
|--|----------|----------|

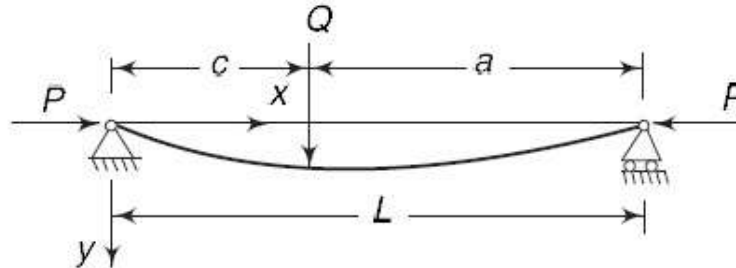


Figure 2

- |   |          |          |
|---|----------|----------|
| <p>Q.2(b) The deflection curve for a pin-ended column is represented by a polynomial as [5]</p> | <p>2</p> | <p>3</p> |
|---|----------|----------|

$$y = ax^4 + bx^3 + cx^2 + dx + e$$

- |   |          |          |
|---|----------|----------|
| <p>Q.3 Determine the critical load by energy method. A cantilever beam of rectangular section is subjected to a load of 1000 N which is inclined at an angle <math>30^\circ</math> to the vertical as shown in Figure 3. Determine the stress due to bending at point D near built-in-end? [10]</p> | <p>3</p> | <p>3</p> |
|---|----------|----------|

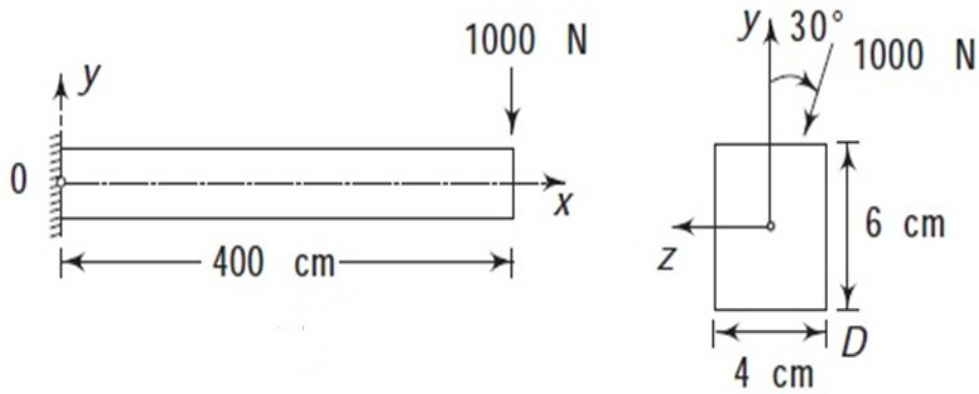


Figure 3

- Q.4 Consider an elliptical bar with semi-axes  $a$  and  $b$  is subjected to a twisting moment  $T$ . [10] 4 6  
Choosing an warping function

$$\psi = \frac{b^2 - a^2}{b^2 + a^2} xy,$$

derive the resultant shearing stress of the bar at point  $(x, y)$ . The plane of cross-section of the bar remains in  $(x, y)$  plane. Also, determine the maximum shear stress.

- Q.5 For a thin solid circular disk of radius  $b$ , derive the expression of thermal stress [10] 5 6  
components. The temperature distribution  $T(r)$  is symmetrical about the center.

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