C 6065 (Pages 3) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2010

ME 04 405—ADVANCED MECHANICS OF SOLIDS

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

I. (a) Define elasticity, body force and surface force. State examples.

(b) Write the tensor matrix for the stress at any point in the material in :

(i) rectangular coordinates.

(ii) cylindrical coordinates.

(iii) spherical coordinates.

(c) What are the effects of stress concentration ? List possible locations of stress concentration.

(d) Define the following terms with example :—

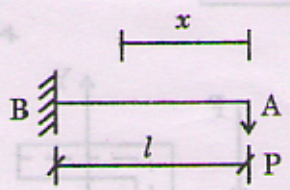
(i) Airy's stress function.

(ii) Stress gradient.

(iii) Stress concentration factor.

(e) Define shear centre. Write down the generalised flexure formula.

(f) Determine the deflection at end A of the centilever beam shown in Figure using energy principles.



(g) Explain Prandtl's membrane analogy.

(h) Write short notes on warping of non-circular section.

(8 × 5 = 40 marks)

Turn over

Part B

II. (a) At a point in a stressed material the principal stresses were obtained as $\sigma_1 = -100$ N/mm^2, $\sigma_2 = -100$ N/mm^2 and $\sigma_3 = 200$ N/mm^2. The direction cosines of the principle planes are $l = m = n = 0.577$. Determine the resultant stresses and the shearing stresses and stress invariants.

(15 marks)

Or

(b) The state of stress of a point is given by $\sigma_x = 70$ MPa, $\sigma_y = 10$ MPa, $\sigma_z = -20$ MPa, $\tau_{xy} = -40$ MPa, $\tau_{yz} = \tau_{zx} = 20$ MPa. Determine the principal stresses, maximum shear stress and maximum principal stress direction.

(15 marks)

III. (a) Derive the equations for analysis of thick cylinder from polar coordinates system.

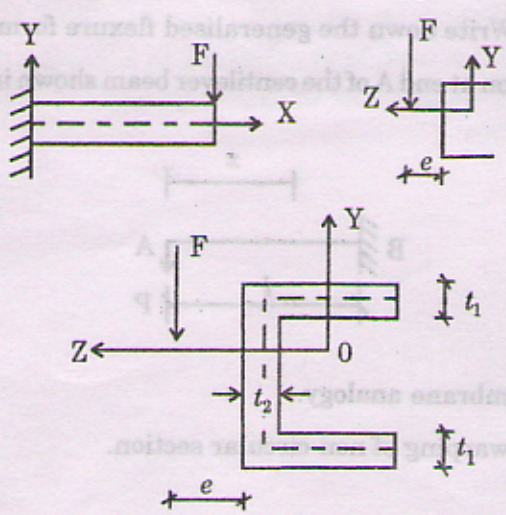
(15 marks)

Or

(b) Derive expressions for the stresses developed in a wedge which is subjected to a concentrated load of P acting at the vertex along the line of symmetry. The angle of the wedge is 2α. Hence find the equations for stresses in the same wedge when the load P is acting normal to the line of symmetry.

(15 marks)

IV. (a) Determine the shear centre of the beam shown in Figure.



(15 marks)

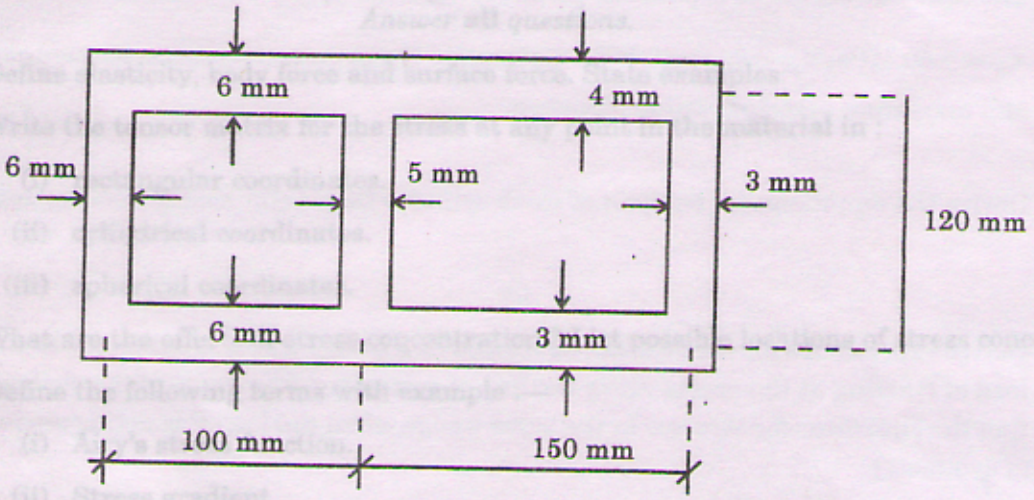
Or

(b) State and prove Castigliano's theorem. (7 marks)

(c) A rectangular beam 80 mm × 100 mm is simply supported at the ends. The beam is 4 m long and carries a load of 2 kN at a distance of 1 m from the left end support. By using Castigliano's theorem, determine the deflection of the beam at mid span. Take $E = 2 \times 10^2$ N/mm^2.

(8 marks)

V. (a) A long tube is subjected to a torque of 200 Nm. The cross section of the tube is shown in figure. Determine the maximum shear stress in each wall of the tube. Assume that twist per unit length of the tube is constant.



(15 marks)

Or

(b) An equilateral triangular section is subjected to a Torque 'T'. From St. Venant's approach derive the expression for stresses in terms of angle of twist and hence find the torsional resistance of the section.

(15 marks)

[4 × 15 = 60 marks]