C 58183 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2009

ME 04 405—ADVANCED MECHANICS OF SOLIDS

(2004 admissions)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

I. (a) Write down the generalized Hooke's law for homogeneous, linearly elastic material.

(b) Define and derive stress gradient.

(c) Write the second degree polynomial equation and its application in two dimensional stress problems.

(d) Write the strain displacement equations and stress-strain relations for plane stress problems in polar co-ordinate system.

(e) Define the theorem of least work. Compute the fixed end moment for the symmetrical fixed beam (i) with a central concentrated load ; (ii) with a uniformly distributed load over the entire span.

(f) Differentiate between thin and thick curved bars subjected to pure bending.

(g) Explain the effect of stress concentration at reentrant corners.

(h) Derive the warping function of bar subjected to torsion.

(8 × 5 = 40 marks)

Part B

II. (a) The state of straight at a point is given by $\epsilon_x = 15\times10^{-4}$, $\epsilon_y = 45\times10^{-4}$, $\epsilon_z = 30\times10^{-4}$ and $\tau_{xy} = 25\times10^{-6}$, $\tau_{yz} = 15\times10^{-6}$, $\tau_{zx} = -30\times10^{-5}$. Determine the strain invariants and the principal strains.

(15 marks)

Or

(b) Using the stress-strain relations and equations of equilibrium, show that in the absence of body forces, the displacements in problems of plane stress must satisfy

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{1+\mu}{1-\mu}\frac{\partial}{\partial x}\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right) = 0$$ and a companion equation. (15 marks)

III. (a) The internal and external diameters of a thin hollow cylinder are 8 cm. and 12 cm. respectively. It is subjected to an external pressure of 40 MN/m^2, when the internal pressure is 120 MN/m^2, calculate the circumferential stress at the external and internal surfaces and determine the radial and circumferential stresses at the men radius. Derive the expression used.

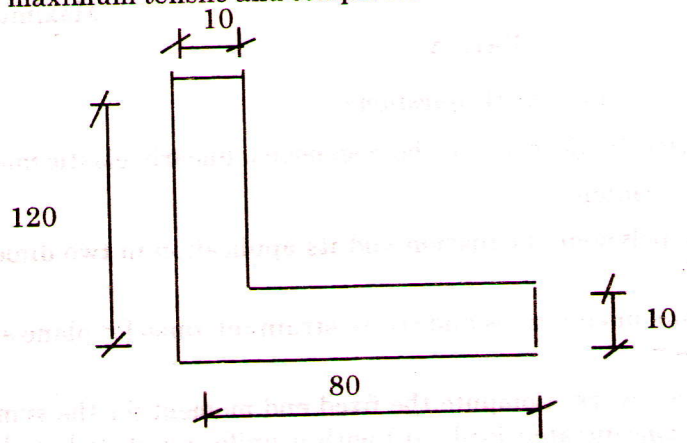
(15 mars)

Or

Turn over

(b) Derive the expressions for stresses in a very large plate subjected to u.d.l. on its free surface. (15 marks)

IV. (a) A angle section beam simply supported over a span of 5 m. is shown in figure. It is subjected to a concentrated load of 4 kN at a distance of 2 m. from left-hand support. The plane of load makes an angle of $\frac{2\pi}{3}$ rad with the z-axis and passes through the shear centre. Determine the maximum tensile and compressive stresses in the section.



(15 marks)

Or

(b) State Maxwell-Betti reciprocal theorem. (3 marks)

(c) For a cantilever beam of length l loaded at the end by a force P, the deflection of the cantilever is given b by :

$$S = \frac{P}{6EI}(2l^3 - 3l^2x + x^3)$$

By using Maxwell Betti reciprocal theorem, determine the deflection of the cantilever beam due to a load Q applied at a distance α from the tip. (12 marks)

V. (a) Determine the expressions for shear stress and displacement for an elliptical shaft subjected to torque. Find the location and intensity of maximum shear stress. (15 marks)

Or

(b) What are the different analogies used in torsion problems ? Explain Prandtl's membrane analogy. (15 marks)

[4 × 15 = 60 marks]