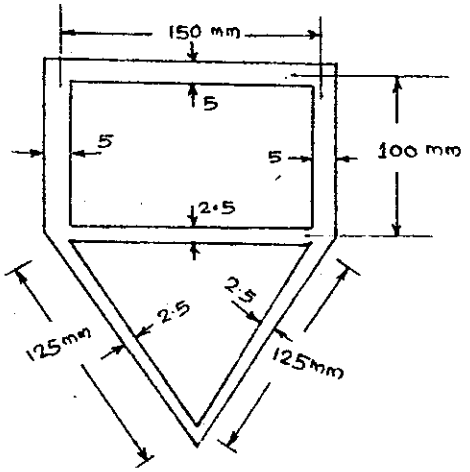
(b) Following figure shows the dimensions of a cross section in the form of a rectangle and a triangle. A torque of 4 kNm is applied. Calculate :
(i) shear stress in each part
(ii) angle of twist per meter length.
Take G = 82 kN/mm² (12)



OR

X. Derive the expression for angle of twist in the torsion of an elliptical bar. (20)

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BTS (C) – V – 04 – 071 (H)

B.Tech. Degree V Semester Examination December 2004

ME 503 ADVANCED MECHANICS OF SOLIDS

(2002 Admissions)

Time: 3 Hours Maximum Marks: 100

I. (a) What is stress function? Explain how the stress function in 2D problems are solved using a third degree polynomial. (10)

(b) In a rectangular rosette, the recorded strains are $E_{0^\circ} = -110\times10^{-6}$, $E_{45^\circ} = 60\times10^{-6}$ $E_{90^\circ} = 110\times10^{-6}$. Find the principal strains. (10)

OR

II. (a) Explain how surface strains are measured. (4)
(b) Derive the boundary conditions for a two dimensional elastic problem. (4)
(c) Explain the components of strain at a point in 2D cartesian co-ordinate system. (4)
(d) The stresses at a point are

$$\sigma x = 8MPa,\ \sigma y = 2MPa \text{ and } \tau_{xy} = -4MPa.$$

Find the principal stresses using Mohr's Circle Method. (8)

III. (a) Derive the equations of equilibrium in two dimensional polar coordinate system. (6)
(b) Explain the strain components in two dimensional polar co-ordinates. (6)
(c) A thin uniform disc of inner radius 5cm and outer radius of 20 cm is rotating at 6000 rpm about its axis. Find out the maximum radial and circumferential stresses. (8)

OR

IV. (a) Derive the expressions for radial and circumferential stress components for a thick cylinder with uniform internal and external pressures. (8)

(b) A thin circular disc of outside radius 50cm having a central hole, rotates at unifrom speed about its axis. The diameter of the hole is such that maximum stress due to rotation is 75% of that in a thin ring whose mean diameter is 60cm. If both are of the same material and rotate at same speed, find out the diameter of the central hole and the speed of rotation, if the maximum allowable stress in the disc is

$120\,MPa$. Take $\mu = 0.3$ and $\rho = 8000\,Kg/m^3$. (12)

V (a) Derive the conditions for compatibility in 3D elastic problems. (8)

(b) The state of stress at a point is given by $\sigma_x = 120\,MPa$,

$\sigma_y = -55\,MPa$, $\sigma_z = -85\,MPa$, $\tau_{xy} = -55\,MPa$,

$\tau_{yz} = 33\,MPa$, $\tau_{zx} = -75\,MPa$. Determine the three principal stresses and their directions. Also calculate the maximum shear stress. (12)

OR

VI (a) Explain stesss invariants. (4)

(b) Derive the equations of equilibrium in terms of displacements. (8)

(c) For the following displacement field, verify whether the compatibility condition is satisfied :

$U = K(x^2 + 2z)$, $V = K(4x + 2y^2 + z)$, $W = 4KZ^2$,

where K is a very small constant. (8)

VII (a) State and explain Castigliano's theorems. What are their advantages? (6)

(b) A cantilever beam of 4 cm x 4 cm section, 2 m long is subjected to a load of 1 KN is acting at the end as shown below.

Contd.....3

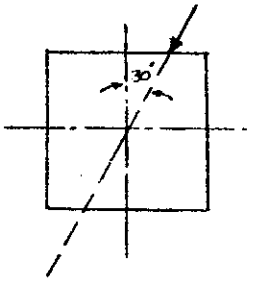
Determine -

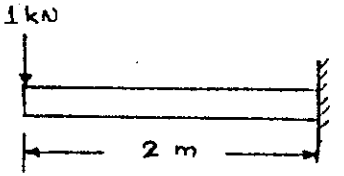
(i) Position of neutral axis

(ii) Maximum stress in the beam

(iii) Maximum deflection and its direction (14)

Take $E = 2 \times 10^{11}$ N/m².



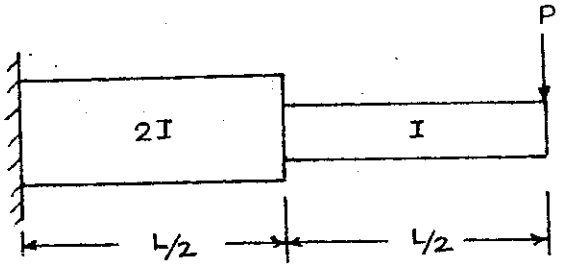


OR

VIII (a) Explain the theorem of virtual work. (6)

(b) Explain the term 'shear center'. (6)

(c) A cantilever beam of stepwise constant cross-section as shown below is loaded by a concentrated force at its tip. Determine the deflection under the point of application of the force by using Castigliano's theorem. (8)



IX (a) Explain the general theorem behind Membrane Analogy. What are its applications? (8)

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