C 47954 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION JUNE 2008

ME/AM 04 304—MECHANICS OF SOLIDS

(2004 admissions)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

1. (a) Explain how thermal stresses are induced.

   (b) Write the Hooke's law for isotropic materials. Derive the relationship between Rigidity modulus and Bulk modulus.

   (c) A thin tube of 100 mm diameter and thickness 1 mm is under a torque of 100 kgm. Find the strain energy per volume stored and the total energy if the length is 5 m.Take $G = 10^5$ kg/cm^2.

   (d) Write a note on : 'Singularities functions and their uses'.

   (e) Explain the direct integration method for beam deflections.

   (f) Find the shear deflection, bending deflecin and total deflection for an edge-loaded cantilever of rectangular cross section.

   (g) At a point in a strained member, the normal stresses along two perpendicular directions are P_1 and P_2 respectively. What will be the normal stress on a plane inclined at θ^o with stress P_1 ?

   (h) Derive the Euler's formula for cripping loads and discuss its limitations.

   ($8 \times 5 = 40$ marks)

2. (a) (i) Derive : $\tau_{ns} = a_{ni}a_{sj}\tau_{ij}$. (6 marks)

   (ii) What do you mean by statically indeterminate system ? Explain with examples.

   (9 marks)

Or

   (b) (i) Explain : Orthotropy. (6 marks)

   (ii) A rod of steel 0.25 m long with cross-sectional area of 20 mm × 20 mm is subjected to a tensile stress at 140×10^6 N/m^2 in the direction of its length. $E = 20 \times 10^{10}$ N/m^2, $\upsilon = 0.30$. Determine the change in volume.

   (9 marks)

Turn over

3. (a) (i) State and explain the theory of torsion. (5 marks)

(ii) A solid circular shaft is to transmit 375 kW at 200 r.p.m. Find the diameter of the shaft if the shear stress is not to exceed 65 N/mm^2. What percentage saving in weight would be obtained if this shaft is replaced by a hollow shaft whose internal diameter is 2/3 of its external diameter assuming the length and material to be same in both ?

(10 marks)

Or

(b) (i) Draw the bending moment and shear force diagram for the cantilever loaded at its free end.

(5 marks)

(ii) Write a note on : Sign conventions for bending moment and shear force. (10 marks)

4. (a) (i) Discuss the moment area method for deflection, stating the relevant theorems.

(7 marks)

(ii) A rectangular beam of span L, depth h and width b is used to support a total uniformly distributed load of w. The beam is simply supported and maximum bending and shear stresses developed are σ_x and τ_{xy}. Determine the ratio of σ_x and σ_y in terms of beam parameters.

(8 marks)

Or

(b) (i) Write a note on : Shear centre and its uses. (5 marks)

(ii) A fixed beam of span 8m carries point loads of 200 kN and 100 kN at a distance of 3 m and 5 m respectively from right support. Find the fixed end moments and draw SFD and BMD.

(10 marks)

5. (a) (i) Discuss the superposition principle and its limitations. (6 marks)

(ii) Find the maximum axial load that a long column of 5 m length and 20 cm diameter can take. The material is structural steel. Thickness of the tube one cm and bottom is fixed to a concrete foundation, top being quite free. Also find the load if the end conditions are different, i.e., both ends pinned, both ends fixed and one end fixed, one pinned.

(9 marks)

Or

(b) (i) Write a note on : Strain Rosettes and their usefulness. (6 marks)

(ii) The state of stress at a point is characterised by the components : σ_x = 12.31 MPa, σ_y = 8.96, σ_z = 4.34, $\tau_{xy} = 4.20$, $\tau_{yx} = 5.27$ and $\sigma_z = 0.84$. Find the values of principal stresses and their directions.

(9 marks)

[4 × 15 = 60 marks]