Printed Pages : 4

CE-302

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : **100302**

Roll No.

B. Tech.

(SEM. III) (ODD SEM.) THEORY EXAMINATION, 2014-15

MECHANICS OF SOLIDS

Time : **3** Hours] [Total Marks : **100**

Note : (1) Assume any suitable data if not provided and mention it clearly.

(2) Attempt **all** questions.

1. Attempt any **four** questions. **5×4=20**

(a) State the generalized Hook's law and prove for an anisotropic elastic material the maximum number of elastic constants is 21 only. Also show that for isotropic materials it is 2.

(b) The modulus of rigidity for a material is 0.5×10^5 N/mm^2. A 12mm diameter rod of material was subjected to axial pull of 14 kN and change in diameter was observed 3.6×10^{-3} mm. Calculate poisson's ratio and modulus of elasticity.

(c) Explain the procedure of drawing Mohr Circle clearly indicating how to obtain principal stress and maximum shear from Mohr circle.

(d) A reinforced column 450 mm × 450mm has four steel rods of 25 mm diameter embedded in it. Find the stresses in steel and concrete when the total load on the column is 1000 kN.

Take $E_S = 2 \times 10^5$ N/mm^2 $E_{conc} = 13.6 \times 10^3$ N/mm^2.

(e) Derive the expression for total strain energy of a freely hanging bar under self weight.

2. Attempt any **two** questions. **2×10=20**

(a) Derive the expression for deflection at the free end of a cantilever beam subjected to uniformly distributed load w along the span 'l'.

(b) State assumptions made in theory of bending. A timber joist of 6m span has to carry a load of 15kN/m. Find the dimension of the joist if the maximum permissible stress is limited to 8N/mm^2. The depth of the joist has to be twice the width. The beam is simply supported.

(c) Determine the dimension of hollow shaft with a diameter ratio 3:4, which is to transmit 80kW at 400 rev/min. The maximum shear stress in the shaft is limited to 80MN/m^2 and the angle of twist is 4.8° in a length of 4m. For the shaft material, G=80Gpa.

3. Attempt any **two** questions. **2×10=20**

(a) A 5m long column with fixed ends supports an axial load of 800 kN. The external diameter of the column is 240mm. Determine the thickness of the column using Rankine's Formula.

(b) A leaf spring has 12 plates each 50mm and 5 mm thick, the longest plate being 600mm long. The greatest bending stress is not to exceed 180N/ mm^2. And the central deflection is 15mm. Estimate the magnitude of the greatest central load that can be applied to the spring. Take E= 0.206 × 10^6 N/mm^2.

(c) Determine the crippling load for the column with one end fixed and other end Hinged.

4. Attempt any **two** questions. **2×10=20**

(a) Derive lame's theorem for thick shell. Also state the assumptions.

(b) A thin cylindrical shell with 0.5m in diameter with 1.2cm thickness and 5m long is filled with fluid at atmospheric pressure. What intensity of pressure will be developed in it if 175cm^3 more fluid is pumped into it. Also calculate circumferential stress at that pressure, increase in diameter and volume of vessel.

Take $E = 2 \times 10^5$ N/mm^2 and $\mu = .3$.

(c) A thin spherical vessel having diameter of 1.50 m is of uniform thickness. It is filled with water at a gauge pressure of 2MPa. A relief valve attached to the vessel is opened and water is allowed to escape until the pressure falls to atmosphere. If the volume of water escaped is 4 litre, find the thickness of the plate of vessel. Bulk modulus of water is 2 GPa and Young's modulus of vessel material is 200 Gpa and Poisson's ratio is 0.30.

5. Attempt any **two** questions. **2×10=20**

(a) A curved beam rectangular in cross section is subjected to pure bending with a couple of 120kNcm. The beam has width of 3cm and depth 6cm and is curved in the plane parallel to width. The mean radius of curvature is 20cm find the position of neutral axis and find stress developed in the beam and plot bending stress variation for the section.

(b) What is shear centre ? Prove that for the shear centre for a thin-walled balanced Z-section coincides with its centroid.

(c) Describe briefly :

(i) Bending of beams with large initial curvature.

(ii) Unsymmetrical bending.
