Reg. No. : | | | | | | | | | | |

Question Paper Code: 52162

M.E. DEGREE EXAMINATION, DECEMBER 2015

First Semester

Structural Engineering

15PSE103 - THEORY OF ELASTICITY AND PLASTICITY

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(5 x 20 = 100 Marks)

1. (a) (i) The stress field in a body is given by

$\Sigma x = 0.005z;\ \gamma xy = 0.003xy$

$\Sigma y = 0.001x;\ \gamma yz = -0.001xz$

$\Sigma z = -0.002xy;\ \gamma zx = 0.001y$ .Check whether it is a compatible strain field. (8)

(ii) Prove that the biharmonic equation for the plane stress condition is $\nabla^4 = d^4/dx^4 + 2(d^4/dx^2dy^2) + d^4/dy^4$. (8)

(iii) Explain the terms (a) plane stress and (b) Hook's law. (4)

Or

(b) (i) Differentiate body force and surface force with examples. (4)

(ii) Differentiate between plane stress and plane strain. (4)

(iii) Derive the equations of equilibrium and compatibility conditions in Cartesian co- ordinates for a two-dimensional stress field (12)

2. (a) (i) A cast iron shaft 500 *mm* diameter is rotating at 3000 *rev/min*. Its density is 747 kg/m^3 and Poisson's ratio 0.28. It is constrained at its ends so that it cannot expand or contract axially. Calculate the total longitudinal thrust over its entire cross section due to centrifugal stresses. (16)

(ii) State the membrane analogy for torsion. (4)

Or

(b) (i) Derive the two-dimentional biharmoic equation in terms of cartersian coordinates. (16)

(ii) State the assumptions followed in torsion problem. (4)

3. (a) (i) State the principle of virtual work and the principle of potential energy. (4)

(ii) Distinguish between the behavior of solid and hollow sections under torsion. (8)

(iii) Explain in detail Membrane analogy. (8)

Or

(b) (i) State St.Venant's principle. (4)

(ii) A 300 *mm* steel beam with flanges and web 12.5 *mm* thick ,flange width 300 *mm* is subjected to a torque of 4 *kN m*. Find the maximum shear and angle of twist per unit length. $G = 100\ GPa$. (16)

4. (a) The state of strain at a point is given by

$\Sigma x = 0.001, \Sigma y = -0.003, \Sigma z = 0.002,$

$\gamma xy = 0.001, \gamma yz = 0.0005, \gamma xz = 0.002$. Determine the strain invariants and the principal strains. (20)

Or

(b) (i) Explain the finite element method in brief and explain the basic steps involved. (16)

(ii) Write short notes on : (1) Resilience and (2) Modulus of resilience. (4)

5. (a) (i) Explain Tresca's yield criteria. (8)

(ii) What are the Plastic stress strain relationships? Explain with neat sketch. (12)

Or

(b) (i) A thick cylinder of internal radius 15*cm* and external radius 25*cm* is subjected to an internal pressure *P MPa*. If the yield stress for the cylinder material is $220 N/mm^2$, determine (1) the pressure at which the cylinder will start yielding just at the inner radius (2) the stresses when the cylinder has a plastic front radius of 20*cm* and (3) the stresses when whole of the cylinder has yielded. Assume Von-Mises yield condition is a state of plane strain. (16)

(ii) What is a plastic hinge? Explain it. (4)

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