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

Question Paper Code: 41264

M.E. DEGREE EXAMINATION, DECEMBER 2014.

First Semester

Structural Engineering

14PSE103 – THEORY OF ELASTICITY AND PLASTICITY

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (5 x 1 = 5 Marks)

1. Strain energy is

(a) Energy stored in a body when strained within elastic limits.

(b) Energy stored in a body when strained up to the breaking of a specimen

(c) Maximum strain energy which can be stored in a body

(d) Proof resilience per unit volume of a material

2. $G\nabla^2 \mathrm{U} + (\lambda + \mathrm{G})\frac{\partial \varepsilon}{\partial \mathrm{x}} + \mathrm{Bx} = 0$ This equation is called as

(a) Slope deflection equation (b) Navier's equation

(c) Poisson's equation (d) None of the above

3. What is the deflection at end of the cantilever beam using castiglianos method

(a) $Pl^3 / 3EI$ (b) $Pl^2 / 3EI$ (c) $Pl^3 / 4EI$ (d) $Pl / 2EI$

4. $\psi = -yx\ (\frac{a^2-b^2}{a^2+b^2})$. Name of the equation is

(a) Equation of torsion hyperbola (b) Equation of rectangular hyperbola

(c) Torsion of elliptical cross section bar (d) All of the above

5. The membrane analogy is used to find out

(a) Analysis of loads (b) Analysis of moments

(c) Shear stress and torque (d) None of the above

PART - B (5 x 3 = 15 Marks)

6. State any two examples each for plane stress and plane strain problem?

7. What is Airy's stress equation?

8. Define warping torsion.

9. Define virtual work.

10. List out the assumptions in yield criteria.

PART - C (5 x 16 = 80 Marks)

11. (a) (i) The state of strain at appoint is given by

$$\varepsilon_x = 0.001, \varepsilon_y = 0.003, \gamma_{xy} = 0, \gamma_{xz} = 0.004, \gamma_{xz} = 0.004, \gamma_{yz} = 0.001.$$

Determine the stress tensor at a point. Take young's modulus E= 210×10^6 k Pa, $\gamma = 0.28$. Also calculate the lami's constant. (8)

(ii) For a shear modulus of 80×10^6 k Pa and elastic modulus of 200×10^6 k Pa, compute the strain tensor for the following strata σ_x= 100 N/mm^2, σ_y= 50 N/mm^2, σ_z= -200 N/mm^2, τ_{xy}= -500 N/mm^2, τ_{xy}= -50 N/mm^2, τ_{xy}= 0. (8)

Or

(b) (i) Explain generalized Hooke's law. (6)

(ii) Derive the equations of equilibrium and compatibility conditions in cartesian co-ordinates for a two-dimensional stress field. (10)

12. (a) Show that $\Phi = q/8C^3 [X^2 (Y^3 - 3C^2 + 2C^3) - (1/5) Y^3 (Y^2 - 2C^2)]$ is a stress function & find what problem it solves when applied to a region included in Y= ±C, X=0 on the side 'X' positive. (16)

Or

(b) Derive Bi-harmonic equation for polar co-ordinates. (16)

13. (a) (i) Briefly discuss Rayleigh-Ritz method. (5)

(ii) Assuming a suitable equation for a deflection curve, determine the deflection of a cantilever beam of span '*l*' carrying a concentrated load 'p' at the free end. (11)

Or

(b) (i) Explain in detail about membrane analogy. (8)

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

14. (a) Derive the equation for torsion of thin walled open and closed section. (16)

Or

(b) Derive torsion of elliptical cross section bar. (16)

15. (a) (i) A thin walled tube of mean radius 100 mm & wall thickness 4 mm is subjected to a torque of 10 Nm. If the yield strength of the tube material is 120 MPa. Determine the value of the axial load applied to the tube. (8)

(ii) A steel of bolt subjected to bending moment of 200Nm and torque of 120 Nm. If the yield stress in tension for the bolt material 250 MPa. Determine the diameter of the bolt according to tresca & vonmises yield criteria. (8)

Or

(b) The state of stress at a point in a material is given by σ_x=35 MPa, σ_y=70MPa, σ_z=140 MPa, $\tau_{xy} = 70\ MPa, \tau_{yz} = 105\ MPa, \tau_{zx} = 35\ MPa$. If the yield stress of the material is 240 MPa. Determine whether failure is eminent or not, based on all failure therories E = 200 MPa, γ =0.3 (16)

———————