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

Question Paper Code: 42662

M.E. DEGREE EXAMINATION, NOV 2016

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. The planes which have no shear stress are known as

(a) Principal planes (b) Principal stress (c) Shear stress (d) Shear stain

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. Shafts are commonly used to transmit power from

(a) one point to many points (b) only one point

(c) only two points (d) three points only

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. Define the terms body force and surface force.

7. What is Airy's stress equation?

8. Write down the principle of virtual work method.

9. Define virtual work.

10. Write down the assumptions of plastic analysis.

PART - C (5 x 16 = 80 Marks)

11. (a) The state of stress at a point is given by σ_x = 70 MPa, σ_Y = 10 MPa, σ_z = -20 MPa and τ_{xy} = -40 MPa, $\tau_{xz} = \tau_{zx}$ = -20 MPa. Determine the principal stresses, maximum shear stresses and the maximum principal stress and its direction. (16)

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 $\varphi = s/4\ [xy - xy^2/c - xy^3/c^2 + ly^2/c + ly^3/c^2]$ is a stress function and identify the problem solved by this stress function when applied to a region included between y ± C and x = 0 on the side x being positive. Compare this solution for normal stress with that obtained using strength of materials approach. (16)

Or

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

13. (a) (i) Briefly discuss Rayleigh-Ritz method. (6)

(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. (10)

Or

(b) The deflection curve for a pin ended column is represented by a polynomial as

$y = ax^4 + bx^3 + cx^2 + dx + e$

Determine the critical load by energy method. (16)

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

Or

(b) A thin walled multiple cell closed section of constant thickness subjected to a twisting moment 'T'. Find the expression for the shear stress and the angle of twist. (16)

15. (a) Discuss in detail about the various theories of elastic failure and their applications.(16)

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)