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

Question Paper Code: 41264

M.E. DEGREE EXAMINATION, MAY 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. A thick cylinder having inner radius 10*cm* and outer radius 15*cm* is subjected to an internal pressure of 12MN/m^2. The value of radial stress in the inner surface is

(a) 12MN/m^2 (b) -12 MN/m^2 (c) 19.2 MN/m^2 (d) 31.2 MN/m^2

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. The torsion equation for non circular sections is

(a) $\nabla^2\emptyset = -2G\theta$ (b) $\nabla^2\emptyset = +2G\theta$ (c) $\nabla^2\emptyset = \frac{-2}{G\theta}$ (d) $\nabla^2\emptyset = \frac{G\theta}{2}$

5. The shape factor for rectangular section is

(a) 2.5 (b) 1.5 (c) 1.25 (d) 2.25

PART - B (5 x 3 = 15 Marks)

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

7. Prove that $\frac{d^4\emptyset}{d\theta^4} + 4\frac{d^2\emptyset}{d\theta^2} = 0$ for Airy's stress function which is independent of *r*.

8. Define warping torsion.

9. A hollow aluminium tube has a rectangular cross section of 0.5*m* x 0.25*m* and thickness 0.06*m*. It is subjected to a torque of 56.5 *kN-m* along the longitudinal axis. Find the shear stress and angle of twist.

10. List out the assumptions in yield criteria.

PART - C (5 x 16 = 80 Marks)

11. (a) A resultant stress of 320 *MPa* is inclined at 39° and 75° with *x* and *y* axes respectively. This resultant stress acts on a plane with normal cosines 0.543, 0.234 relative to *x* and *y* axes respectively. Determine the normal and shear stress on this plane. Given the component of shear stress τ_{xy} = 18 *MPa* and τ_{xz} = 20 *MPa.* Find the normal stress with invariant J_1 = 1000 *MPa.* (16)

Or

(b) Derive the equilibrium equations in Cartesian coordinates in terms of displacements (Navier's equations). (16)

12. (a) Determine the stress components in a narrow cantilever beam having of length "*L*" and of depth "2*C*" and width "1" unit subjected to a load *P* at the free end. Assume the following stress function $\emptyset = b_2xy + \frac{d_4}{6}xy^3$. (16)

Or

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

13. (a) Find the deflection at the centre of a simply supported beam subjected to load *F* at the centre using Rayleigh Ritz method. Take $y = \sum_{n=1}^{k} a_n Sin\frac{n\pi x}{l}$. (16)

Or

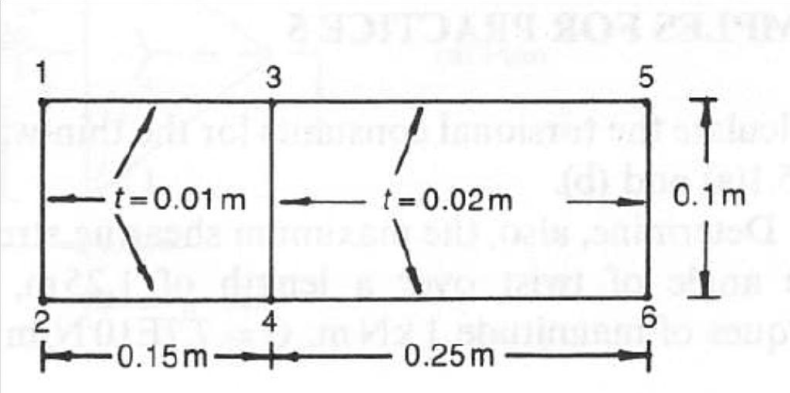
(b) (i) Explain in detail about membrane analogy. (8)

(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) Determine the values of the shear stress for the two - cell thin walled tube shown in the following figure due to the application of a torque of 2000*N-m*. Hence or otherwise determine the angle of twist/length. Take $G = 7.7 \times 10^{10}\ N/m^2$.



(16)

15. (a) A cylindrical bar of cast iron is subjected to an anticlockwise bending moment of $M = 39N\text{-}m$ and a twist moment of $T = 225N\text{-}m$. The diameter of the bar is $D = 20mm$. If the material of the bar fails at $\sigma_{yield} = 128MPa$ in a simple tension test, will failure of the bar occur according to the maximum principal stress criterion?

(16)

Or

(b) The state of stress at a point in a material is given by σ_x=35 *MPa*, σ_y=70 *MPa*, 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 theories $E = 200\ MPa$, γ =0.3. (16)

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