Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code: U1502

M.E. DEGREE EXAMINATION, NOV/DEC 2024

First Semester

Structural Engineering

21PSE102– THEORY OF ELASTICITY AND PLASTICITY

(Regulations 2021)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 20 = 100 Marks)

1. (a) The displacement field components at a point are given by   CO2 - App (20)
         $u = -0.0001 y^3 + 0.0015 xyz$, $v = 0.0002 x^2y + 0.0003 x^2z$ and $w = 0.0015 xyz + 0.0002 x^2yz$.
         i) Determine the strain tensor at a point $(2,-3,-1)$
         ii) Find the principal strain and their orientation.
         iii) If E = 210GPA and $\upsilon = 0.28$, find Lame's constants.

                                          Or

    (b) The state of stress at a point is given by σ_x= 4MPa, σ_y= 6MPa, σ_z=   CO2 - App (20)
         8MPa, $\tau xy = 1$MPa, $\tau yz = 0$MPa, $\tau zx = 2$MPa.   Find the stress
         invariants remain unchanged by transformation of the axes by 45°
         about the *z*-axis.

2. (a) Illustrate the airy's stress function by direct method.   CO1 - App (20)
                                          Or
    (b) State plane stress and plane strain. Discuss the plane stress and plane   CO1 - App (20)
         strain for two dimensional problems with illustrations.

3. (a) Derive the expression for the rotations at A of a simply supported   CO3 - Ana (20)
         beam AB with UDL over the entire span.
                                          Or
    (b) Explain in detail various strain gauges and their importance in static   CO3 - Ana (20)
         field testing.

4. (a) Derive the expression for shear stress of a bar with elliptical cross section subjected to a torque T   CO3 - Ana   (20)

<center>Or</center>

    (b) Investigate the equation for torque by prandlt's stress function approach.   CO3 - Ana   (20)

5. (a) Comparison of the theoretical design approach to a 'thumb rule' approach, highlighting the advantages and challenges.   CO2 - App   (20)

<center>Or</center>

    (b) A rectangular beam having linear stress-strain behavior is 6cm wide and 8cm deep. It is 3m long, simply supported at the ends and carries a uniformly distributed load over the whole span. The load is increased so that the outer 2cm depth of the beam yields plastically. If the yield stress for the beam material is 240MPa, illustrate the residual stress distribution in the beam.   CO2 - App   (20)