Roll No. | | | | | | | | | | | | |  Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(ANE) (Sem.–7,8)

# THEORY OF ELASTICITY

Subject Code : ANE-414

Paper ID : [A2069]

Time : 3 Hrs. Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

## SECTION–A

**1. Write briefly :**

a) Difference between plane stress and plane strain problems.

b) Biharmonic equation in terms of stress function.

c) Governing equation of equilibrium for stress distribution in determing rotating discs.

d) Stress-optic law.

e) Plane Polariscope.

f) Stress-director surface.

g) Saint-venant approach for solving torsion problems.

h) Strain components in terms of displacements in polar coordinates.

i) Assumptions made in solving torsion problems by semi-inverse method.

j) Isoclinics and Isochromatics.



## SECTION–B

2. Show that the equation of compatibility is given by

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)(\delta_x+\delta_y)=\delta$$

What are the assumptions under which this equation is valid?

3. Establish an analogy relating to the torsion of an arbitrarily shaped bar to the deflected shape of a membrane.

4. An Airy Stress function is:

$$\phi = Axy^3$$

Sketch the stress components on a rectangular plate shown in Fig 1. assuming the constant A is be positive.

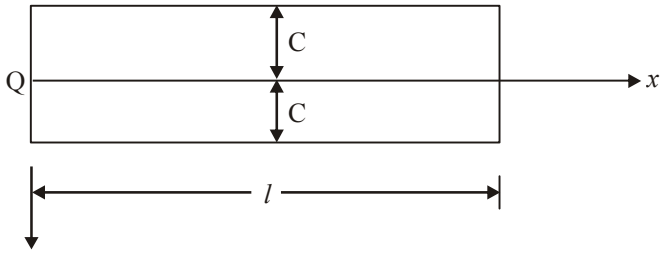


**Fig. 1**

5. A narrow rectangular strip shown in Fig. 2 is subjected to a torque of 7.5 kNm. Calculate:

a) The rate of twist

b) The maximum shear stress

Given G = 100 GN/m$^2$

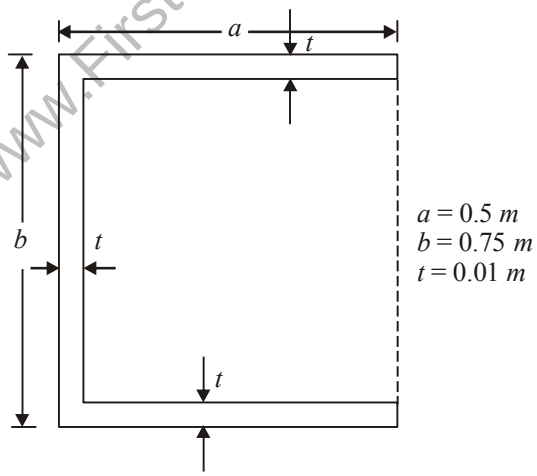


**Fig. 2**

6. The radial stress distribution in a circular disc of radius $b$ with a circular hole of radius $a$ at the centre rotating with an angular velocity $\omega$ is given by:

$$\delta_r = \left(\frac{3+\mu}{8}\right)\rho\omega^2 + \left[b^2 + a^2 - \frac{a^2b^2}{r^2} - r^2\right]$$

Show that:

$$(\delta_r)_{max} = \beta\left(\frac{3+\mu}{8}\right)\rho\omega^2$$

State the value of $\beta$ in terms of $a$ and $b$.

**SECTION–C**

7. A bar of narrow rectangular cross-section with a circular axis is constrained at the lower end and bent by a force P applied at the other end in a radial direction as shown in Fig 3.

Using the stress function

$$\phi = \left(Ar^3 + \frac{B}{r} + Cr + Dr\log r\right)\sin\theta,$$

Obtain the stress components $\delta_r$, $\delta_\theta$ and $\tau_{r\theta}$.

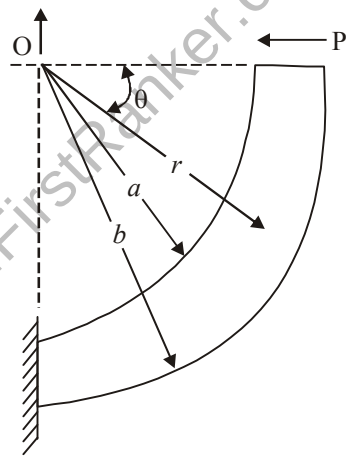


**Fig. 3**

8. Making suitable assumptions, derive expressions for stress and displacement distribution in a bar which is stretched by its own weight.

9. Write notes on:

(a) Saint-venant method of solving Torsion problems of prismatical bars

(b) Three Dimensional Photoelasticity.