S6 ME Old Central Library

G 441

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Mechanical Engineering

MECHANICS OF MATERIALS (M)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer **all** *questions.*

Each question carries 4 *marks.*

1. State Hooke's law. Write down the Hooke's law relations for the normal strain in three directions.
2. Write down the strain displacements of a three dimensional elasticity problem.
3. Write down the differential equation for a two-dimensional elasticity problem with zero body force. Mention how this equation can be solved.
4. What are strain invariants ? Write down its expressions in terms of Cartesian components of strain.
5. Write down the expressions for stain in polar co-ordinates.
6. Write down the differential equation of equilibrium of a rotating disc.
7. What are photoelastic contours ? How it is helpful in identifying the regions of stress concentration.
8. Determine the components of stress for the displacement field given by $u = Axy$ $v = Bxz^2$ $w = c\,(x^2 + y^2)$.
9. What is a Mohr's circle of stress ? Explain how it is constructed for a two-dimensional problem.
10. What is Chain link ?

(10 × 4 = 40 marks)

Part B

Answer **all** *questions.*

Each question carries 12 *marks.*

11. Investigate what problem is solved by the stress function :

$$\phi = \frac{-F}{d^3} xy^2 \ (3d - 2y)$$

applied to the region included in $y = 0$, $y = d$, $x = 0$, on the positive side of x-axis.

Or

Turn over

12. A stress state is given by

$\sigma_x = \sigma_y = \sigma_z = \tau_{xy} = \tau_{yx} = 0$

$\tau_{xz} = \tau_{zx} = -G\theta y$, $\tau_{yz} = \tau_{zy} = G\theta x$,

where 'θ' is a constant. Check whether then stress satisfy the conditions of equilibrium. Also show that the lateral surface is free of load.

13. Write down the expressions of stress invariant. For the state of stress given below, obtain the principal stresses :

$$\sigma = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}.$$

Or

14. The displacement field in micro meter for a body is given by :

$u = (x^2 + y)i + (3 + z)j + (x^2 + 2y)k$. Determine the principal stains at (3, 1, –2) and the direction of minimum principal strain.

15. Determine the value of the constant C in the stress function $\phi = Cr^2(\cos 2\theta - \cos 2\alpha)$ required to satisfy the conditions :

$\sigma_\theta = 0 \quad \tau_{r\theta} = s$ on $\theta = \alpha$

$\sigma_\theta = 0 \quad \tau_{r\theta} = -s$ on $\theta = -\alpha$

Or

16. Derive the equations of equilibrium in polar co-ordinates.

17. A thick-walled steel cylinder with radii a = 5 cm and b = 10 cm is subjected to an internal pressure P. The yield stress in tension for the material is 350 MPa. Using a factor of safety, determine the maximum working pressure P.

Take $E = 207 \times 10^6$ kPa, V = 0.25.

Or

18. Derive the equations of stress distribution in a thick cylindrical shell.

19. Describe with the help of an example, the method of photo elastic stress determination.

Or

20. Derive the equation for 'e' in bending of a beam of rectangular cross-section as $e = \rho_0 - \dfrac{h}{m\left(\dfrac{r_2}{r_1}\right)}$

with usual notations.

(5 × 12 = 60 marks)