



B.E DEGREE EXAMINATIONS: APRIL/ MAY 2016

(Regulation 2013)

Sixth Semester

AERONAUTICAL ENGINEERING

U13AEE603: Theory of Elasticity

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

- General Anisotropic material has _____ independent constants.
 - 2
 - 21
 - 9
 - 5
- Strain is a _____ order tensor
- The compatibility condition in theory of elasticity ensures that
 - Stresses satisfy bi-harmonic equation
 - Displacements are single-valued and continuous
 - Relationship between stresses and strains are consistent with constitutive relations
 - There is compatibility between various direct and shear stresses
- Lame's constant λ is given by-----
- Can you solve the problem of rectangular bar subjected to torsion from strength of materials approach?
 - Yes, solution is different from the beam under bending
 - Yes, solution is same as the beam under bending
 - No, because plane sections do not remain plane before and after loading
 - No, because rectangular bar cannot be subjected to torsion
- For Axi-symmetric problems $\sigma_{\theta} =$ -----
- Uniaxial thick specimen can be solved by theory of elasticity using _____
 - Plane stress assumption
 - Plane strain assumption
 - Both a and b
 - Using line element
- For Axi-symmetric problems is independent of----- coordinates.
- The tubes will not warp under torsion are called
 - Single cell tubes
 - Multi-cell tubes
 - Pressurized tubes
 - Neuber tubes
- Saint Venant's method is also called as _____ method.

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. Draw a small element and mark the stress components in Cartesian co-ordinate system.
12. $\sigma_x = 20x^3 + y^2$; $\sigma_y = 30x^3 + 100$; $\sigma_z = 30y^2 + 30z^3$; $\tau_{xy} = 100 + 80y^2$; $\tau_{yz} = 0$; $\tau_{zx} = xz^3 + 30x^2y$ MPa. Find body force distribution that is required for equilibrium.
13. State St. Venant's principle.
14. If $E=200\text{GPa}$, $\nu=0.3$ find a) Lamé's constant b) Shear modulus.
15. List out the difference between Plane stress and plane strain condition.
16. The strain components at a point are given by $\epsilon_x = 20x^3 + y^2$; $\epsilon_y = 30x^3 + 100$; $\gamma_{xy} = 90xy^2 + x^2y$; Verify whether compatibility equation are satisfies at a point(1,1).
17. Write the equilibrium equation in 3D polar coordinate?
18. Define Boussinasque problem.
19. State the assumption involved in Saint Venant's method.
20. Explain Prandtl's theory on torsion?

PART C (5 x 14 = 70 Marks)

(Answer not more than 400 words)

Q.No. 21 is Compulsory

21. (i) Derive the equations of equilibrium for Cartesian coordinates. (10)
(ii) Define the terms anisotropic, isotropic, and orthotropic. (4)
22. (a) Derive the normal and shear strain displacement relation for Cartesian coordinates
(OR)
(b) The following Cartesian stress components (in N/mm^2) exist at a point in a body subjected to 3D stress system $\sigma_x=20$, $\sigma_y=40$, $\sigma_z=-20$, $\tau_{xy}=-40$, $\tau_{yz}=20$, $\tau_{zx}=-60$. Determine the minimum principal stress?
23. (a) Find displacements for cantilever beam with tip load using plane stress assumption.
(OR)
(b) A simply supported beam (SSB) of length $2L$ and of rectangular cross section, depth $2c$ and unit width is subjected to uniformly distributed load q . Obtain the stresses, strains and displacements using elasticity approach.
24. (a) Derive the expression for a Airy's stress function in polar co-ordinates.
(OR)
(b) Derive the expressions for stresses at any point in a plate of infinite dimension with a small central circular hole under uni-axial tension.
25. (a) Derive the expression for the torsion of equilateral triangular bar of side $2a$.
(OR)
(b) Derive the expression for shear stresses and angle of twist/unit length for an elliptical cross section subjected to torsion.
