



Register Number: .....

**B.E DEGREE EXAMINATIONS: NOV/DEC 2014**

(Regulation 2009)

Sixth Semester

**AERONAUTICAL ENGINEERING**

AER127: Theory of Elasticity

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. The study of relationships between loads applied on a deformable body internal loads generated in that body and the Deformations of that body
  - a) Factor of safety
  - b) Mechanics of materials
  - c) Modulus of toughness
  - d) Modulus of resilience
2. At ultimate stress the cross-section area of the specimen begins to decrease in a localized region is .....
  - a) Yielding
  - b) Stress
  - c) Axial load
  - d) Necking
3. The ability to go under large deformations before failure
  - a) Stress
  - b) Modulus of toughness
  - c) Yielding
  - d) Modulus of resilience
4. The ability of the material to absorb energy without any permanent Deformation
  - a) Factor of safety
  - b) Modulus of resilience
  - c) Elastic behavior
  - d) Modulus of toughness
5. The sum of all forces in any direction is equal to zero so that the deformable body is in equilibrium although might deformed under set of loads
  - a) Modulus of toughness
  - b) Equilibrium of deformable body
  - c) Modulus of resilience
  - d) Mechanics of materials

6. The property of a deformable body when it is subjected to an axial compressive force not only does it shortened but it also expands laterally is generally mentioned using
  - a) Poisson's ratio
  - b) Shear stress
  - c) Shear strain
  - d) Hooke's law
7. The property of a material when it returns to its original shape or length when the load acting on it is removed is known as
  - a) Elastic behavior
  - b) Yielding
  - c) Shear strain
  - d) Axial load
8. Ratio of the ultimate strength of the material to the allowable stress
  - a) Normal stress
  - b) Thermal stress
  - c) Factor of safety
  - d) Strain energy
9. Internal energy related to the strains in deformable bodies
  - a) Necking
  - b) Strain energy
  - c) Strain hardening
  - d) Stress
10. Stress smaller than the ultimate strength of the material by a margin to ensure safety
  - a) Thermal stress
  - b) Shear stress
  - c) Allowable stress
  - d) Normal stress

**PART B (10 x 2 = 20 Marks)**

11. What are the assumptions made in TOE?
12. Define: Principal stress and principal plane?
13. State the stress compatibility eqn for plane stress problem
14. Explain St.Venant's Principle.
15. For a material with  $E=210\text{GPa}$ ,  $\nu =0.3$  Find (i) Lamé's constant (ii) Shear modulus (iii) Bulk modulus.
16. How is the stress in 2D Cartesian coordinate system expressed in terms of Airy stress function?
17. What are the non-vanishing stress and strain components for axi symmetric problems?
18. Sketch the distribution of radial and hoop stress across the thickness of a thick hollow cylinder subjected to internal pressure only.
19. Define warping in non-circular cross sections.
20. What are the non-vanishing stress and strain components for torsional problem of non-circular cross section?

**PART C (5 x 14 = 70 Marks)**

21. a) From first principles derive the equilibrium equations in Cartesian coordinates for general three dimensional state of stress and explain the significance of the equations.

**(OR)**

- b) Drive the relations between the elastic constants E,G and K.

22. a) The state of stress at a point is given by

$$\begin{pmatrix} 100 & 200 & 100 \\ 200 & -200 & -300 \\ 100 & -300 & 400 \end{pmatrix} \text{ MPa}$$

Determine the principle stresses and principle directions.

**(OR)**

- b) Derive the strain compatibility conditions for a problem in 3D Cartesian coordinate system.

23. a) Using Airy stress function approach, Explain with a neat sketch which polynomial can represent pure bending case.

**(OR)**

- b) A cantilever beam having a narrow rectangular cross section is subjected to a downward shearing load on its end face. Explain the procedure of solving this problem using the theory of elasticity approach. State clearly all assumptions and also boundary conditions.

24. a) A large rectangular plate has a small hole at its center. The plate is subjected to uni-axial tensile stress. Obtain the expressions for stress distribution around the periphery of the hole at the center. Sketch the tangential stress distribution along the periphery of the hole.

**(OR)**

- b) Obtain expressions for the radial stresses and hoop stresses in a hollow cylinder rotating at an angular velocity. Sketch the distribution of radial and hoop stresses across the cross section.
25. a) Find the stress and displacements in a shaft with elliptical cross section subjected to a torque using St. venant's semi inverse method.

**(OR)**

- b) Explain Prandtl's theory of torsion and what are its limitations?

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