



M.E DEGREE EXAMINATIONS: DEC 2022

(Regulation 2018)

First Semester

STRUCTURAL ENGINEERING

P18SET1001: Advanced solid Mechanics

COURSE OUTCOMES

CO1: Formulate equilibrium and compatibility equations for 3D problems

CO2: Formulation of boundary value problems in linearized elasticity and solution of 2D problems using Airy's stress functions.

CO3: Solution to boundary value problems corresponding to end torsion of prismatic beams

CO4: Analyse using plastic theories

CO5: Analyse using fracture mechanics

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which of the following is not the 2-dimensional imperfection? CO1 [K₂]
 - a) Twin boundary
 - b) Dislocation
 - c) Surface
 - d) Grain boundary

2. Figure out the odd one in the following. CO1 [K₁]
 - a) Frenkel defect
 - b) Tilt boundary
 - c) Twist boundary
 - d) Stacking fault

3. Thermodynamically stable defects CO5 [K₂]
 - a) Point defects
 - b) Line defects
 - c) Surface defects
 - d) Volume defects

4. Match List I and List II

CO2 [K₂]

List I	List II
A. $EI \frac{d^4y}{dx^4}$	i. Shear force
B. $EI \frac{d^3y}{dx^3}$	ii. Load
C. $EI \frac{d^2y}{dx^2}$	iii. Slope
D. $EI \frac{dy}{dx}$	iv. Bending moment

- a) A-2 B-1 C-4 D-3 b) A-3 B-1 C-4 D-2
 c) A-1 B-2 C-3 D-4 d) A-3 B-1 C-2 D-4

5. The materials which have the same elastic properties in all directions are called

CO3 [K₁]

- a) Brittle b) Isotropic
 c) Homogenous d) Hard

6. What is the effect of hammering on elasticity of materials?

CO4 [K₂]

- a) Has no effect on elasticity b) Decreases the elasticity
 c) Increases the elasticity d) Breaks the material

7. Engineering stress-strain curve and True stress-strain curve are equal up to

CO3 [K₂]

- a) Proportional limit b) Elastic limit
 c) Yield point d) Tensile strength point

8. Stress in a beam due to simple bending is

CO2 [K₁]

- a) Directly proportional b) Curvilinear related
 c) Inversely proportional d) None of these

9. Von-Mises and Tresca criteria give different yield stress for

CO4 [K₂]

- a) Uni-axial stress b) Balanced bi-axial stress
 c) Pure shear stress d) Bending stress

10. Consider the following statements.

CO3 [K₂]

Assertion(A): In elastic stage, strain is proportional to stress within elastic limit.

Reason(R): In Plastic stage, strain is proportional to stress.

Now Select your answer according to the coding scheme given below

- a) Both (A) and (R) are false b) Both (A) and (R) are true and (R) is not the correct explanation of (A)
 c) Both (A) and (R) are true and (R) is the correct explanation of (A) d) (A) is True, but (R) is false

PART B (10 x 2 = 20 Marks)

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|------------------------------------------------------------------------|--|-----|-------------------|
| 11. Compare surface force and body force. | | CO1 | [K ₂] |
| 12. Define generalized Hooke's law. | | CO1 | [K ₁] |
| 13. Differentiate uniform and non-uniform state of stress. | | CO2 | [K ₂] |
| 14. Show that 3rd degree polynomial satisfies the governing equations. | | CO2 | [K ₂] |
| 15. Write the concept of membrane analogy. | | CO3 | [K ₂] |
| 16. Illustrate St.Venant's Theory of torsion. | | CO3 | [K ₂] |
| 17. Outline Prandtl stress function. | | CO4 | [K ₂] |
| 18. List the yield conditions in plasticity. | | CO4 | [K ₂] |
| 19. Write a short note on Linear elastic fracture mechanics. | | CO5 | [K ₂] |
| 20. What are failure criteria and mention its types. | | CO5 | [K ₂] |

PART C (6 x 5 = 30 Marks)

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| 21. Develop the equations of equilibrium for 3D Problems in Cartesian coordinates | 5 | CO1 | [K ₃] |
| 22. Comprise the compatibility equation in 3-D Cartesian co-ordinates. | 5 | CO1 | [K ₃] |
| 23. Prove that the following Airy's stress functions and examine the stress distribution represented by them:
a) $\phi = Ax^2 + By^2$, b) $\phi = Ax^3$ | 5 | CO2 | [K ₃] |
| 24. Derive the equations for torsion of an elliptical cross section bar section by analogous methods. | 5 | CO3 | [K ₃] |
| 25. Detail the experimental verification of St. Venant's theory of plastic flow in detail. | 5 | CO4 | [K ₂] |
| 26. Derive the two-dimensional biharmonic equation in terms of Cartesian coordinates. | 5 | CO2 | [K ₃] |

Answer any FOUR Questions

PART D (4 x 10 = 40 Marks)

27. Determine principal strains where the components of a strain at point are given by normal components are in order x, y, z is 0.2,-0.08, 0.10 and shear components are in order xy, yz, zx is 0.3, 0.1,-0.08. 10 CO1 [K₃]
28. Describe the various modes of failure conditions and design in fracture mechanics. 10 CO5 [K₂]
29. Differentiate Von-mises yield criterion and Tresca yield criterion. 10 CO4 [K₂]
30. Derive the expression for the angle of twist and shear stress at any point and hence maximum shear stress in a bar of elliptical cross section due to a torque T. 10 CO3 [K₃]
31. Discuss the Kirsch effect of circular hole on stress distribution in a thin rectangular plate subjected to uniaxial tension. 10 CO2 [K₃]
