**QUESTION BANK**

**Composite Materials**

1. Define composite material.

2. What is the need for composite material?

3. Mention important characterits of composite material

4. Give examples for fiber material

5. Mention important matrix materials

6. Define lamina

7. Write the generalized Hooks Law for composite materials

8. What are composite materials?

9. Classify composite material.

10. What is the role of matrix is a composite material?

11. What is the role reinforcement in composite materials?

12. What are the advantages of composite materials?

13. Give examples use of composite materials.

14. List types of fibres used in FRP.

15. What are various types of Matrices used in FRP?

16. Give relative merits of:

Carbon fibre

Glass fibre

Aramid fibre

Natural fibre

17. List the characteristics of matrix material.

18. What are laminae?

19. What is laminate and how it is classified?

20. List components of stress-strain in a 3-D continuum.

21. What is plane stress condition?

22. Write the compliance matrix for plane stress.

23. Write stiffness matrix for plane stress.

24. What is the relevance of plane stress condition, which is the behaviour of laminae?

25. What is a cross-ply laminate?

26. What is an angle-ply laminate?

27. Write transformation matrix for an angle-ply matrix.

28. How engineer properties of a laminate are predicted from micromechanics?

29. Write the laminate stress-strain relation in material coordinate.

30. Write the laminate stress-strain relation in laminate global coordinate system.

31. What is classical plate theory? Discuss assumptions.

32. Discuss classical laminate theory.

33. Write structural strain relation for laminates.

34. What are the laminate stress relations?

35. Discuss significance of A, B, D matrices.

36. Write laminate strain resultants?

37. Write A, B, D matrices for:

38. Symmetric laminate

39. Antisymmetric laminate

40. Unsymmetric laminate

41. What are various failure theories?

42. Discuss the design concepts.

43. Describe various manufacturing techniques.

44. Write stability laminations of various manufacturing techniques.

45. Write the various engineering applications of composites.

**Self-Assessment Questions**

**Indicate whether statements 1 to 6 are true or false.**

1. According to the maximum stress criterion lamina failure is determined by the absolute maximum component of stress in the lamina.

(A) true

(B) false

2. The maximum stress and maximum strain criteria will predict the same failure loads.

(A) true

(B) false

3. A hybrid stress criterion is used for composites containing more than one fibre type (i.e. a hybrid composite).

(A) true

(B) false

4. An interactive stress criterion cannot directly predict the mode of failure.

(A) true

(B) false

5. An interactive criterion will always predict failure stresses different to those predicted by the maximum stress criterion.

(A) true

(B) false

6. When predicting the final failure of a laminate it is necessary to know the failure mode of individual plies.

(A) true

(B) false

**For each of the statements of questions 7 and 8, one or more of the completions given are correct. Mark the correct completions.**

7. Maximum strain criterion

(A) can be obtained from the maximum stress criterion by dividing each term by an appropriate stiffness,

(B) comprises five sub-criteria,

(C) cannot predict failure stresses,

(D) will give the same prediction as the maximum stress criterion for a lamina in a uniaxial stress state when the stress is parallel to the fibres,

(E) gives a better prediction than the maximum stress criterion when the stress-strain relation shows significant nonlinearity.

8. Tsai-Hill criterion

(A) is only applicable if the direct stresses are tensile,

(B) cannot predict the mode of failure,

(C) gives better prediction than does a limit criterion for a unidirectional lamina when the fibres are not aligned with the applied stress,

(D) cannot be used to predict the final failure of a laminate,

(E) cannot be used to obtain a reserve factor.

**Each of the sentences in questions 9 to 15 consists of an assertion followed by a reason.**

**Answer:**

(A) if both assertion and reason are true statements and the reason is a correct explanation of the assertion,

(B) if both assertion and reason are true statements but the reason is not a true explanation of the assertion,

(C) if the assertion is true but the reason is a false statement,

(D) if the assertion is false but the reason is a true statement,

(E) if both the assertion and reason are false statements.

9. A lamina is deemed to have failed when the fibres fracture because the fibres carry the highest stresses.

10. When predicting the failure of an off-axis lamina it is necessary to calculate the stresses in the principal directions because these stresses are always greater than the applied stresses.

11. The maximum stress criterion will always predict failure in tension because the longitudinal tensile strength of a unidirectional ply is greater than the corresponding compressive strength.

12. The Tsai-Hill criterion gives a more accurate prediction for off-axis loading because it does not predict the mode of failure.

13. Initial failure of a cross-ply laminate can only be predicted by the Tsai-Hill criterion because it corresponds to transverse ply cracking.

14. Prediction of laminate failure requires an iterative approach because ply stiffnesses are modified as failures occur.

15. Classical Laminate Theory cannot predict failure of finite width laminates because it ignores the existence of through-thickness stresses.

**Answers**

1. B; 2 - B; 3 - B; 4 - A; 5 - B; 6 - A; 7 - B, D, E; 8 - B, C; 9 - B; 10 - C; 11 - D; 12 - B; 13 - D; 14 - A; 15 - A.

**Multiple Choice Questions’ Bank:**

1. Composite materials are classified based on:

(a) Type of matrix (b) Size-and-shape of reinforcement (c) Both (d) None

2. Major load carrier in dispersion-strengthened composites

(a) Matrix (b) Fiber (c) Both (d) Can’t define

3. Usually softer constituent of a composite is

(a) Matrix (b) Reinforcement (c) Both are of equal strength (d) Can’t define

4. Usually stronger constituent of a composite is

(a) Matrix (b) Reinforcement (c) Both are of equal strength (d) Can’t define

5. Last constituent to fail in fiber reinforced composites

(a) Matrix (b) Fiber (c) Both fails at same time (d) Can’t define

6. Size range of dispersoids used in dispersion strengthened composites

(a) 0.01-0.1 μm (b) 0.01-0.1 nm (c) 0.01-0.1 mm (d) None

7. Rule-of-mixture provides \_\_\_\_\_\_\_\_\_ bounds for mechanical properties of particulate composites.

(a) Lower (b) Upper (c) Both (d) None

8. Al-alloys for engine/automobile parts are reinforced to increase their

(a) Strength (b) Wear resistance (c) Elastic modulus (d) Density

9. Mechanical properties of fiber-reinforced composites depend on

(a) Properties of constituents

(b) Interface strength

(c) Fiber length, orientation, and volume fraction

(d) All the above

10. Longitudinal strength of fiber reinforced composite is mainly influenced by

(a) Fiber strength (b) Fiber orientation (c) Fiber volume fraction (d) Fiber length

11. The following material can be used for filling in sandwich structures

(a) Polymers (b) Cement (c) Wood (d) All

12. Not an example for laminar composite

(a) Wood (b) Bimetallic (c) Coatings/Paints (d) Claddings

Answers:

1. c

2. a

3. a

4. b

5. a

6. a

7. c

8. b

9. d

10. a

11. d

12. a