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V 4008

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Seventh Semester

Aeronautical Engineering

AE 1402 — COMPOSITE MATERIALS AND STRUCTURES

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What do you mean by composite material?
2. What is meant by Fiber – Reinforced composite material? Give an example.
3. Define the rule of mixture used to determine the material properties.
4. Define
 - (a) Lamina
 - (b) Laminate.
5. Graphically represent the following laminate
 - (a) $(0/\overline{90})_S$
 - (b) $((\pm 45)_2 90)_S$.
6. Define cross - ply laminate.

7. Graphically represent the sandwich beam and hence represent its cross-section.
8. Why low-modulus foam or honeycomb core is used in the middle of the sandwich beam?
9. Differentiate between bag moulding and compression moulding.
10. State the importance of Fiber surface treatments.

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the advantages of composite materials in compare with isotropic materials. (6)
- (ii) State various applications of composite materials. (6)
- (iii) Differentiate between isotropic, anisotropic and orthotropic materials with suitable example. (4)

Or

- (b) (i) State the generalised Hooke's law applicable for orthotropic material. (6)
- (ii) Applying Maxwell – Betti Reciprocal theorem, derive the stiffness matrix for 2D – plane stress fiber reinforced lamina. (10)
12. (a) Starting from Kirchoff hypothesis, derive mid-plane strains and curvatures in terms of displacements and hence derive the contents of A, B and D matrices of a laminate? (16)

Or

- (b) A three ply laminate having its top and bottom layers are each 6 mm thick and oriented at 45° to the laminate reference axis, where as the 5 mm thick mid ply layer is oriented at 0° . Obtain A, B and D matrices if each lamina has its properties referred to the principal material

direction is given as $[Q] = \begin{bmatrix} 22 & 0.9 & 0 \\ 0.9 & 3 & 0 \\ 0 & 0 & 0.9 \end{bmatrix} \text{ GPa}.$

13. (a) Explain the following characteristics with mathematical expressions for the following :
- (i) Symmetric laminates. (6)
 - (ii) Cross - ply laminates. (4)
 - (iii) Angle - ply laminates with equal number of $I \theta^{\circ}$ plies. (6)

Or

- (b) Derive the governing differential equation starting from the force and moment equilibrium conditions for the bending of a composite plate applied with load along 2 - direction, and also state the assumptions and limitations of the governing equation. (16)

14. (a) Discuss in detail design concepts for construction of a sandwich beam. (16)

Or

- (b) Discuss the following Failure theories applicable for composite materials.
- (i) Maximum stress theory. (4)
 - (ii) Azzi - Tsai - Hill theory (6)
 - (iii) Tsai - Wu theory. (6)

15. (a) Explain the production of bag moulding with its advantages and disadvantages. (16)

Or

- (b) Write a detailed account about manufacturing of various fibers used in composites. (16)
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