Reg. No. : | | | | | | | | | | | | |

Question Paper Code : P 1019

B.E./B. Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

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 are advanced composites?

2. What are the matrix and fiber factors which contribute to the mechanical performance of a composite?

3. Find the transverse Young's modulus of a glass/epoxy lamina with a fiber volume Fraction of 70%. E_f = 85 GPa, E_m = 3.4 GPa.

4. What is meant by Strength ratio?

5. What is meant by orthogonally anisotropic material? Give an example.

6. Condense the expanded laminate code [0/45/-45/-45/45/0].

7. What are the desirable properties of resins?

8. Give an example of a laminate with zero coupling stiffness matrixes.

9. What are the merits and demerits of Tsai- hill failure theory?

10. List down the advantages of using a sandwich construction.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine the elastic stiffness matrix [C] and compliance matrix [S] for an orthotropic laminate. The material properties of the laminate with respect to the principal material directions are E_1 = 810 Mpa, E_2 = 270 Mpa, υ_{12} = 0.25 and G_{12} = 135 Mpa. Also calculate the elastic stiffness matrix [C] if the angle between the principal material direction 1 and the arbitrary loading direction is 45°. (12)

(ii) What is the effect of voids in composites? (4)

Or

(b) (i) For glass- epoxy composite E_f = 85 Gpa, E_m = 3.4Gpa, γ_m = 0.3 and ν_f = 0.25 , find the minor Poisson's ratio ν_{21} and G_{12} for a fiber volume fraction of 60%. (8)

(ii) What weight of glass fibers must be added to 1 kg of epoxy to produce a composite with a density of 1600 kg/m³ ρ_f = 2500 kg/m³ and ρ_m = 1200 kg/m³. (8)

12. (a) Using elasticity approach, Obtain an expression for the upper bound on apparent Young's modulus for anisotropic composite materials.

Or

(b) (i) Obtain an Lamina stress strain relations for a lamina with respect to arbitrary axes. (10)

(ii) The stresses in the global axes of a 30° ply are given as σ_x = 4 MPa, σ_y = 2 MPa and τ_{xy} = -3 MPa Find the stresses in the local axes. (6)

13. (a) What are the assumptions made in modified Netting analysis and hence obtain an expression for the hoop stress and longitudinal stress of a hemispherical cylinder subjected to internal pressure.

Or

(b) (i) Explain the Tsai-Hill and Tsai-Wu failure theories used for a lamina. (10)

(ii) Obtain an expression for the in-plane shear strength of a lamina (6)

14. (a) Derive the governing differential equation for a laminated unidirectional anisotropic plate and deduce the conditions for orthotropic and isotropic plates.

Or

(b) Find the in plane and flexural stiffness constants for a three ply [0/90]s graphite/epoxy laminate. Each lamina is 6 mm thick. The properties of unidirectional graphite/epoxy are E_1 = 181 GPa, E_2 = 10.3 Gpa, ν_{12} = 0.28 and G_{12} = 7.17 GPa.

15. (a) Obtain an expression for the flexural modulus of a

(i) Sandwich plate with different face thickness. (8)

(ii) Sandwich plate with different face thickness and material. (8)

Or

(b) (i) Explain with neat sketches the production of carbon fibers (8)

(ii) Write short notes on vacuum bag molding and continuous poltrusion. (8)