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Question Paper Code : 90078

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Sixth/Seventh Semester

Aeronautical Engineering

AE 8603 – COMPOSITE MATERIALS AND STRUCTURES

(Common to: Aerospace Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Note down the different types of reinforcement and matrices in a composite materials.
2. Define study of micro-mechanics.
3. State generalized Hooke's law with expression.
4. Draw the stress-strain diagram for a composite material.
5. Differentiate between cross-ply laminate and angle-ply laminate.
6. Define anti-symmetric laminate with an example.
7. List various open moulding and close moulding process.
8. What are the raw materials used in the production of carbon fibres?
9. List materials used for sandwich construction.
10. Note down the advantages using sandwich construction.

PART B — (5 × 13 = 65 marks)

11. (a) What is the role of reinforcement and resin in a composite material? Explain the application and advantages of composite materials in aircraft construction.

Or

- (b) Define volume fraction and mass fraction with expression. Derive the expressions for E_1 and E_2 for a uni-directional lamina using the mechanics of materials approach.
12. (a) Define Poisson's ratio and discuss generalized Hooke's law for isotropic and anisotropic materials.

Or

- (b) Explain the different failure theories of a uni-directional lamina.
13. (a) State the failure criteria for a composite laminate. Explain the procedure for finding the successive loads between first ply failure and last ply failure.

Or

- (b) Write notes on (i) netting analysis (ii) impact resistance of a composite laminate (iii) inter-laminar stresses
14. (a) With the help of neat sketches explain any one method for each of the following.

- (i) Open moulding process
(ii) Close moulding process

Or

- (b) (i) Explain the different types of repair techniques used in composites.
(ii) How are glass fibres manufactured?
15. (a) (i) Explain the aspects to be considered in designing sandwich structures.
(ii) Write about stress variation in the cross-section of a sandwich beam.

Or

- (b) Discuss on the different failure modes of sandwich construction. Draw neat sketches.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Mathematically discuss how one can relate the global stresses to local stresses. (7 ½)
- (ii) Write about the experimental determination of mechanical properties for a composite lamina. (7 ½)

Or

- (b) (i) Derive the hygrothermal stress-strain relationship for a unidirectional lamina. (7)
- (ii) For a 60° angle lamina of Glass/Epoxy: Find the strains under a temperature change of -100°C and a moisture absorption of 0.02 kg/kg. Assume, the co-efficient of thermal expansions as $\alpha_1 = 8.6 \times 10^{-6} \text{ m/m}^\circ\text{C}$, $\alpha_2 = 22.1 \times 10^{-6} \text{ m/m}^\circ\text{C}$ and co-efficient of moisture expansion as $\beta_1 = 0 \text{ m/m/kg/kg}$, $\beta_{21} = 0.6 \text{ m/m/kg/kg}$. (8)

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