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17ME652

Sixth Semester B.E. Degree Examination, July/August 2022

Mechanics of Composite Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define Composite Material. Explain briefly classification of composites based on Reinforcement. (10 Marks)
- b. List the difference between Thermosets and Thermoplastics with examples. (05 Marks)
- c. With neat sketch explain Sandwich Composites. (05 Marks)

OR

- 2 a. Explain with neat sketch fabrication of FRP's using Filament Winding technique. (10 Marks)
- b. With neat sketch discuss fabrication of MMC's using powder metallurgy technique. (10 Marks)

Module-2

- 3 a. Derive an expression for longitudinal Young's modulus and transverse Young's modulus for a unidirectional lamina. (14 Marks)
- b. Find the longitudinal elastic modulus of a unidirectional glass/epoxy lamina with a 70% of fibre volume fraction. Young's modulus of fibre and matrix are 85 GPa and 3.4 GPa respectively. Find the ratio of the load taken by the fibers to that of the composite. (06 Marks)

OR

- 4 a. Write a short notes on:
 - i) Mechanics of load transfer from matrix to fiber.
 - ii) Load transfer in particulate composites (12 Marks)
- b. Give the expression for
 - i) Thermal expansion coefficients of composites
 - ii) Thermal conductivity of composites. (08 Marks)

Module-3

- 5 a. What is lamina and laminate? Explain stress-strain matrix and compliance matrix for
 - i) Transversely Isotropic material
 - ii) Orthotropic material (10 Marks)
- b. Find the compliance and stiffness matrix for graphite / epoxy lamina. The material properties are as follows:
 $E_1 = 181 \text{ GPa}$, $E_2 = E_3 = 10.3 \text{ GPa}$, $\gamma_{12} = 0.28$, $\gamma_{23} = 0.6$, $\gamma_{13} = 0.27$, $G_{12} = 7.17 \text{ GPa}$,
 $G_{23} = 3 \text{ GPa}$, $G_{31} = 7 \text{ GPa}$. (10 Marks)

OR

- 6 Write short notes on:
 - i) Variation of lamina properties with orientation
 - ii) Stresses and strains in a laminate composites
 - iii) Interlaminar stresses and edge effects. (20 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

Module-4

- 7 Discuss in detail about
- Tensile and compressive strength of unidirectional fiber composites.
 - Fracture modes in composites
 - Concept of Debonding and Fiber pullout in composite materials. (20 Marks)

OR

- 8 a. Explain the following :
- Tsai – Hill failure theory
 - Maximum strain failure theory (12 Marks)
- b. Find the maximum value of $s > 0$, if a stress of $\sigma_x = 2s$, $\sigma_y = -3s$ and $\tau_{xy} = 4s$ is applied to a 60° angle lamina of graphite / epoxy unidirectional lamina. Use maximum stress failure theory. Use the properties of unidirectional lamina as
- $$\left(\sigma_1^T\right)_{ult} = 1500 \text{ MPa}, \quad \left(\sigma_1^C\right)_{ult} = 1500 \text{ MPa}, \quad \left(\sigma_2^T\right)_{ult} = 40 \text{ MPa}, \quad \left(\sigma_2^C\right)_{ult} = 246 \text{ MPa},$$
- $$\left(\tau_{12}\right)_{ult} = 68 \text{ MPa}.$$
- (08 Marks)

Module-5

- 9 Represent the laminate code and discuss its importance of the following laminates:
- Symmetric laminate
 - Cross-ply laminate
 - Angle ply laminate
 - Antisymmetric laminate
 - Balanced laminate (20 Marks)

OR

- 10 Discuss in detail about
- Failure criterion for a laminate (10 Marks)
 - Design of a laminated composite. (10 Marks)
