CBCS SCHEME

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18MDE332

Third Semester M.Tech. Degree Examination, Dec.2019/Jan.2020
Composite Materials Technology

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is composite? How do you classify composite materials and mention its advantages and limitations? **(10 Marks)**

b. What are prepregs? Explain the manufacturing of prepregs along with sketch. **(10 Marks)**

OR

2 a. Differentiate between lamina and laminate. Explain compliance and stiffness matrix for :
(i) Orthotropic material (ii) Transversly isotropic material. **(10 Marks)**

b. Find the compliance and stiffness matrix for graphite/epoxy lamina. The material properties are given as $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $E_3 = 10.3$ GPa, $\delta_{12} = 0.28$, $\delta_{23} = 0.60$, $\delta_{13} = 0.27$, $G_{12} = 7.17$ GPa, $G_{23} = 3.0$ GPa, $G_{31} = 7.00$ GPa. **(10 Marks)**

Module-2

3 a. Derive an expression for longitudinal Young's modulus and transverse Young's modulus for a unidirectional lamina using strength of material approach. State the assumptions to be made in the approach. **(12 Marks)**

b. Find the longitudinal elastic modulus of a unidirectional glass/epoxy lamina with a 70% fiber volume fraction Young's modulus of fiber and matrix is 85 GPa and 3.4 GPa respectively. Also find the ratio of the load taken by the fiber to that of the composite. **(08 Marks)**

OR

4 a. Explain the following:
(i) Maximum strain failure theory
(ii) Tsai-Hill failure theory **(10 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 60° angle lamina of graphite-epoxy unidirectional lamina. Use maximum stress failure theory. Use the properties of unidirectional lamina as $(\sigma_1^T)_{ult} = 1500$ MPa, $(\sigma_1^C)_{ult} = 1500$ MPa, $(\sigma_2^T)_{ult} = 40$ MPa, $(\sigma_2^C)_{ult} = 246$ MPa and $(\tau_{12})_{ult} = 68$ MPa. **(10 Marks)**

Module-3

5 a. With assumptions, derive [A], [B] and [D] matrices for the laminate from fundamentals. **(12 Marks)**

b. A 0.010 min thick laminate is subjected to a plane loads. The midplane strains and curvatures are given as follows. Find the global strains at the top surface of the laminate.

$$\begin{bmatrix} \varepsilon_x^o \\ \varepsilon_y^o \\ Y_{xy} \end{bmatrix} = \begin{bmatrix} 2751 \\ -1331 \\ -1125 \end{bmatrix} \mu \text{ mm/mm} \quad \text{and} \quad \begin{bmatrix} K_x \\ K_y \\ K_{xy} \end{bmatrix} = \begin{bmatrix} 1.965 \\ 0.2385 \\ -1.773 \end{bmatrix} \text{mm/mm}$$ **(08 Marks)**

OR

6 Find the three stiffness matrices [A], [B] and [D] for three ply[0/30/–45] graphite/epoxy laminate, with each ply of 5 mm thick. Given that $\sigma_1 = 2$ MPa, $\sigma_2 = -3$ MPa, $\tau = 4$ MPa, $E_1 = 181$ GPa, $E_2 = 10.2$ GPa, $\delta_{12} = 0.28$ and $G_{12} = 7.17$ GPa. **(20 Marks)**

Module-4

7 a. What is optimization? What are the parameters to be discuss with applications? **(08 Marks)**

b. Discuss different types of optimization problems in composite structure. **(12 Marks)**

OR

8 Discuss the following with respect to the applications of the composites:

(i) Automobile
(ii) Marine
(iii) Electrical and Electronics
(iv) Medical **(20 Marks)**

Module-5

9 Briefly explain the following:

(i) Filament Winding Technique
(ii) Pultrusion process **(20 Marks)**

OR

10 What is NDT? Explain the following NDT techniques to composite materials:

(i) Radiograohy Technique
(ii) Ultrasonic Testing **(20 Marks)**

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