CBCS SCHEME

USN | | | | | | | | | | |

18AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Introduction to Composite Materials

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Assume missing data suitably.***

Module-1

1 a. Define a composite material. Explain how composites are broadly classified. **(10 Marks)**
b. Differentiate between thermosetting and thermoplastic polymer. **(06 Marks)**
c. Write a note on laminated composites. **(04 Marks)**

OR

2 a. Explain the following methods of processing MMC's:
(i) Solid state processing (any one method)
(ii) Liquid state processing (any one method) **(16 Marks)**
b. List the properties of MMC. **(04 Marks)**

Module-2

3 a. Discuss the filament winding technique of preparing laminated composites with neat sketch. **(10 Marks)**
b. Explain the pultrusion process with neat sketch. **(10 Marks)**

OR

4 a. Explain with neat sketch the injection moulding process. **(08 Marks)**
b. Explain Laser beam cutting of composites with neat sketch. **(08 Marks)**
c. Write a note on Adhesive bonding. **(04 Marks)**

Module-3

5 a. Using strength of material approach, derive expression for effective axial modulus, and major Poisson's ratio of a UD lamina. **(12 Marks)**
b. A glass/epoxy lamina consists of a 70% of fiber volume fraction. Assume the density of fiber and matrix are $\rho_f = 2500$ kg/m^3 and $\rho_m = 1200$ kg/m^3 respectively. Determine:
(i) Density of composite
(ii) Mass fraction of glass and epoxy
(iii) Volume of composite lamina, if the mass of lamina is 4 kg
(iv) Volume of fiber and epoxy
(v) Mass of fiber and epoxy **(08 Marks)**

OR

6 a. Derive the stress-strain relationship for a 2D unidirectional angle lamina in its global and local axes. **(10 Marks)**

b. For a 60° angle lamina of graphite/epoxy as shown in Fig.Q6(b). Find the: (i) Compliance matrix (ii) Global strain. If the applied stress are $\sigma_x = 2$ MPa, $\sigma_y = -3$ MPa and $\tau_{xy} = 4$ MPa, find: (iii) Local stress (iv) Local strain. The properties of the lamina are $\gamma_{12} = 0.28$, $G_{12} = 7.17$ GPa, $E_1 = 181$ GPa, $E_2 = 10.3$ GPa.

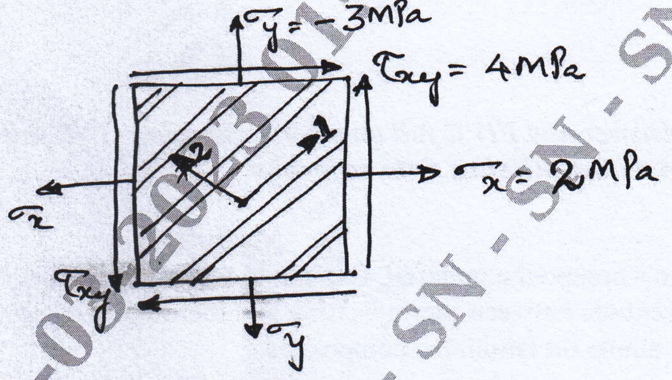

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Write a note on Tsai Hill theory and Tsai-Wu failure theory. **(10 Marks)**

b. Find the maximum value of s > 0 if a stress of $\sigma_x = 2s$, $\sigma_y = -3s$, $\tau_{xy} = 4s$ is applied to the 60° lamina of graphite/epoxy. Use maximum stress failure theory and the properties of unidirectional lamina are $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $(\sigma_1)_{ult} = \pm 1500$ MPa, $(\sigma_2)_{ult}^T = 40$ MPa, $(\sigma_2)_{ult}^C = -246$ MPa, $(\tau_n)_{ult} = \pm 68$ MPa. Also find the maximum stress that can be applied before failure. **(10 Marks)**

OR

8 a. Derive A, B and D matrix by considering force, stress-strain and moments. **(10 Marks)**

b. Find A, B, D matrices for the 2 ply laminate as shown in the Fig.Q8(b). Assume both the laminate have identical stiffness matrix Q as follows:

$$[Q] = \begin{bmatrix} 13 & 2.5 & 0 \\ 2.5 & 1 & 0 \\ 0 & 0 & 3.5 \end{bmatrix} \text{ GPa}$$

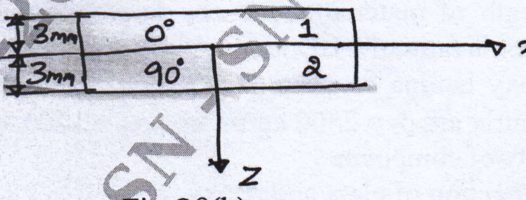

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Suggest the experimental setup to test composite for tension and shear properties. **(10 Marks)**

b. Explain the application of composites in Aircraft field. **(10 Marks)**

OR

10 a. Explain ultrasonic testing of composites. List its advantages. **(10 Marks)**

b. Discuss the application of composite in sports and automobile fields. **(10 Marks)**

* * * * *