CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

17ME652

Sixth Semester B.E. Degree Examination, Feb./Mar. 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. Classify composite materials on the basis of matrix reinforcement. Explain the role of matrix and reinforcement in composites.   **(12 Marks)**
    b. Distinguish between thermoplastic and thermoset polymers.   **(08 Marks)**

OR

2   a. With a neat sketch, explain the following:
        (i)   Vacuum Bag Moulding
        (ii) Blow moulding technique for fabricating MMC's   **(14 Marks)**
    b. List the advantages and disadvantages of PMC's over MMC's.   **(06 Marks)**

Module-2

3   a. Using strength of material approach, derive the modulus of elasticity equation for FRP along fiber direction (E_1), and state the assumptions made in SOM approach.   **(12 Marks)**
    b. The Glass/epoxy lamina is developed with 70% fiber volume fraction. Determine:
        (i)   Longitudinal Young's modulus (E_1)
        (ii) Major Poisson's ratio (μ_{12})
        (iii) Transverse young's modulus (E_2)
        (iv) Minor's Poisson's ratio (μ_{21})
        Consider the properties of fiber as $E_{Glass} = 85$ GPa, $\mu_{glass} = 0.2$, $G_{glass} = 35.42$ GPa and $E_{poxy} = 3.4$ GPa, $\mu_{epoxy} = 0.3$, $G_{epoxy} = 1.308$ GPa   **(08 Marks)**

OR

4   a. Write a short note on load transfer in particulate composite.   **(06 Marks)**
    b. Derive the expression for thermal expansion coefficients of composites.   **(14 Marks)**

Module-3

5   a. What is laminate? Explain in brief.   **(06 Marks)**
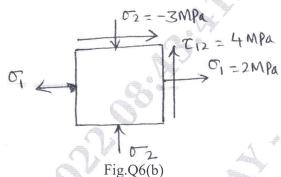   b. Derive [A], [B] and [D] matrices for laminate from fundamentals.   **(14 Marks)**

OR

6   a. Discuss the inter-laminar stresses and edge effects.   **(06 Marks)**
    b. For a Graphite/expoxy unidirectional lamina, find following:
        (i)   Compliance matrix
        (ii) Minor Poisson's ratio
        (iii) Reduced stiffness matrix
        (iv) Strains in 1-2 coordinate system, if applied stresses as shown in Fig.Q6(b).

$\sigma_2 = -3 \text{MPa}$
$\tau_{12} = 4 \text{MPa}$
$\sigma_1 = 2 \text{MPa}$
σ_1
σ_2

Fig.Q6(b)

The properties of graphite/epoxy lamina is $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $\mu_{12} = 0.28$, $G_{12} = 7.17$ GPa

(14 Marks)

Module-4

7 a. Write short note on:
   (i) Saint-Venant principle
   (ii) Tsai-Hill theory of failure of lamina (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 the $60°$ lamina of graphite/epoxy. Use maximum stress failure theory and properties of unidirectional graphite/epoxy lamina as given below:
   $(\sigma_1^T)_{ult} = 1500$ MPa, $(\sigma_2^T)_{ult} = 40$ MPa, $(\sigma_1^C)_{ult} = 1500$ MPa,
   $(\sigma_2^C)_{ult} = 246$ MPa, $(\tau_{12})_{ult} = 68$ MPa (10 Marks)

OR

8 a. Write a short note on tensile and compressive strength of unidirectional fiber composites.
   (10 Marks)

   b. Explain the fatigue of particle and whisker reinforced composites with sketch. (10 Marks)

Module-5

9 a. Classify the laminates based on configuration and briefly describe angle ply and balanced laminates. (12 Marks)

   b. Explain the fatigue criteria for a laminate. (08 Marks)

OR

10 a. Write the optimizing and constraining factors in the design of laminated composites.
    (08 Marks)

    b. Write the explanatory notes on the applications of composites in following fields:
       (i)   Recreational and sports equipments
       (ii) Space industry
       (iii) Missile industry
       (iv) Marine industry

(12 Marks)

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