

B.Tech IV Year II Semester (R15) Advanced Supplementary Examinations July 2019

COMPOSITE MATERIALS

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 1 Answer the following: (10 X 02 = 20 Marks)
- Define composite materials.
 - Write any four applications of composite materials.
 - How is FRP made?
 - Write the compliance matrix for orthotropic material.
 - Define void in composite material.
 - What is unidirectional composite?
 - How do composite laminates behave under load?
 - State the assumptions made in thin plate theory.
 - What is balanced laminate?
 - Write the equation of Tsai-Hill theory of composite material.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

- 2 (a) Discuss briefly the desirable characteristics of fiber in a fiber reinforced composites.
(b) Write a brief note on engineering applications of composites.

OR

- 3 List and explain the properties and applications of:
- Glass fibers.
 - Carbon fibers.

UNIT – II

- 4 With suitable sketches, explain the following methods of manufacturing PMC's:
- Filament Winding.
 - Hand Lay-Up.

OR

- 5 Write generalized Hooke's law in matrix form. Deduce the stiffness matrix & compliance matrix for a lamina from generalized Hook's law.

UNIT – III

- 6 Derive the expressions to E_{11} , E_{22} , γ_{12} and G_{12} in terms of constituent properties using micromechanics principles.

OR

- 7 (a) Mention the assumptions made in the mechanics of material approach model to determine the four elastic moduli.
(b) Find the longitudinal elastic modulus of a unidirectional glass/epoxy lamina with a 70% fiber volume fraction. Also find the ratio of the load taken by the fibers to that of the composite. Take $E_f = 85 \text{ GPa}$, $E_m = 3.4 \text{ GPa}$.

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UNIT – IV

- 8 Derive the constitutive relations for a multidirectional composite in a hygrothermal environment.

OR

- 9 What is lamination theory? Describe with a sketch of laminate stacking sequence code.

UNIT – V

- 10 What is Tsai-Hill criterion? Explain.

OR

- 11 Check the failure of a unidirectional lamina with Tsai-Wu failure criterion using the following properties:

$$\sigma_1 = 800 \text{ MPa}, \sigma_2 = 300 \text{ MPa}, \sigma_{12} = 50 \text{ MPa}$$

$$X_{11}^t = 1500 \text{ MPa}, X_{11}^c = -1250 \text{ MPa}, X_{22}^t = 50 \text{ MPa}$$

$$X_{22}^c = -200 \text{ MPa}, X_{12} = -100 \text{ MPa}.$$

