

Total Pages—4

(Set-Q₁)

M.Tech-1st (Civil-SE)
Composite Materials

Full Marks : 70

Time : 3 hours

Answer Q.No.1 and any five from the remaining

The figures in the right-hand margin indicate marks

Assume any missing data suitably

1. Answer any *ten* questions : 2 × 10

- (i) Give two examples of man-made composite.
- (ii) Among the different fibres such as E-glass, S-glass, Kevlar 49 and carbon T-300, which have positive coefficient of thermal expansion ?
- (iii) Differentiate between lamina and laminate.
- (iv) Give one example each of symmetric and anti-symmetric laminates.

(Turn Over)

(2)

(v) Write any two applications of fibre reinforced composite.

(vi) Write the expanded form of $[+30/-30]_s$ and $[+30/+45/+60]_2$.

(vii) Differentiate between angle-ply laminate and cross-ply laminate.

(viii) Give two examples of asymmetric balanced laminate.

(ix) Define specific strength and specific modulus.

(x) Find out the longitudinal modulus of unidirectional composite from the fibre and matrix properties. (1 & 2 are the directions along and perpendicular to the fibre orientation, respectively)

$$E_{11f} = 15 \text{ GPa} \quad E_{11m} = 4 \text{ GPa} \quad \text{Fiber volume} = 0.55$$

(xi) Define shear coupling coefficient.

2. Discuss the various types of fibres and matrices used in the fibre-reinforced laminated composites. 10

(3)

3. A carbon/epoxy unidirectional lamina of fibre angle 45° is subjected to a stress system of $\sigma_x = 800$ MPa, $\sigma_y = -130$ MPa and $\tau_{xy} = 60$ MPa. The ply properties are as follow :

$$E_1 = 150 \text{ kN/mm}^2, E_2 = 14 \text{ kN/mm}^2, G_{12} = 7 \text{ kN/mm}^2,$$

$$\nu_{12} = 0.3, F_{11}^t = 1580 \text{ MPa}, F_{11}^c = 1200 \text{ MPa},$$

$$F_{22}^t = 65 \text{ MPa}, F_{22}^c = 240 \text{ MPa}, F_{12} = 80 \text{ MPa}$$

Check the safety of the lamina using maximum stress and maximum strain theories of failure. 10

4. Derive the transformation of strain of a unidirectional lamina for 1-2 axis system to xy -axis system. 10

5. Compute B_{ij} and D_{ij} for a laminated composite $[0/90]_2$ laminate of total thickness of 4 mm. Each lamina has equal thickness. The lamina properties are given below : 10

$$Q_{11} = 260 \text{ GPa}, Q_{22} = 20 \text{ GPa}, Q_{12} = 7 \text{ GPa} \text{ and} \\ Q_{66} = 8 \text{ GPa}.$$

(4)

6. Explain Tsai-Hill strength criterion for an orthotropic lamina. 10
7. Derive the expression for deflection of all edges simply supported rectangular symmetric cross-ply laminate subjected to a uniformly distributed lateral load. 10
8. (a) Write down the advantages and disadvantages of metal matrix composites. 6
(b) Write short note on thermoplastic matrix. 4