

Code: MEMD1T3

I M.Tech-I Semester-Regular Examinations-April 2013

**MECHANICS OF COMPOSITE MATERIALS
(MACHINE DESIGN)**

Duration: 3hours

Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. (a) Write about Carbon- Carbon Composite? Mention their advantages and Disadvantages. Over other Composites?
7 M
- (b) Explain in detail the applications of each composite?
7M
2. (a) What are the main characteristics of a thermosetting polymer? Explain.
7 M
- (b) A hybrid composite is defined as a material containing two or more different types of reinforcing fibers. What advantages would such a composite have over other Composites?
7 M
3. (a) Explain the filament winding process with neat diagram?
7 M

(b) Explain the RTM process with neat diagram? 7 M

4. (a) Describe stress strain relations for a lamina of arbitrary orientation. 7 M

(b) A symmetric angle ply laminate has the following data:
4 layers of each 0.5 mm thick $+45^{\circ} / -45^{\circ} / -45^{\circ} / +45^{\circ}$
 $E_l = 210$ GPa, $E_t = 21$ GPa, $V_{lt} = 0.3$ and $G_{lt} = 7$ GPa.
Compute the in plane stiffness matrix of the laminate. 7 M

5. Explain Tsai- Hill failure theory used for anisotropic materials.

Show that for unidirectional lamina the failure theory can be written as

$\frac{\sigma_1^2}{X^2} - \frac{\sigma_1\sigma_2}{X^2} + \frac{\sigma_2^2}{Y^2} + \frac{\tau_{12}^2}{S^2} = 1$ where σ_1 , σ_2 , τ_{12} are the stress components with respect to principal material direction and X, Y and Z are the failure strengths of lamina. 14 M

6 (a) What is rule of mixture ? Explain a uni-directional Kevlar 49 fiber epoxy composite contains 60% by volume of Kevlar 49 fibers and 40% epoxy resin. The density of Kevlar 49 fibers is 1.48 Mg/m^3 and that of the epoxy resin is 1.20 Mg/m^3 .

- (i) What are the weight percentages of Kevlar 49 and epoxy resin in the composite material and
- (ii) What is the average density of composite? 7 M
- (b) Discuss the behavior of fiber composites under compressive loads. 7M
7. (a) Explain in detail warpage of laminates? 7 M
- (b) Show the stress strain relationship for the laminates 7M
8. For a graphite/epoxy unidirectional lamina, find the following.
- (a) Compliance matrix.
- (b) Minor poisons ratio.
- (c) Reduced stiffness matrix
- (d) Strains in the 1-2 co-oridnate system if the applied stresses are $\sigma_1=2\text{Mpa}$, $\sigma_2=-3\text{Mpa}$, $\sigma_{12}=4\text{Mpa}$, $E_1=181\text{Gpa}$, $E_2=10.3\text{Gpa}$, $V_{12}=0.28$, $G_{12}=7.17\text{ Gpa}$. 14 M