Code: **MEMD1T3**

### I M.Tech - I Semester - Regular Examinations – April, 2015

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

Duration: 3 hours                                           Marks: 5x14=70

Answer any FIVE questions.   All questions carry equal marks

1. a) What are the constituents in a typical composite material? Give the classification of the composite materials.          7 M

   b) Explain how the fiber reinforced composite materials are different from particle reinforced composite materials and list their applications.          7 M

2. a) Explain the characteristics of the two most common polymer matrix materials used with high performance reinforcing fibers.          7 M

   b) List out different reinforcement materials used in composite materials. Discuss their specific applications.          7 M

3.   Discuss in detail any two methods of manufacturing thermosetting resin matrix composite materials.          14 M

4. a) For a unidirectional lamina in the state of plane stress, express the stress-strain relations in material coordinate system.  **8 M**

   b) A unidirectional lamina is loaded under a uniaxial stress $\sigma_1 = \sigma_0$, and principal strains $\varepsilon_1$ and $\varepsilon_2$ are measured. Compute transverse strain $\varepsilon_2'$ of the same lamina loaded under biaxial normal stresses $\sigma_1 = \sigma_2 = \sigma_0$ as a function of $\varepsilon_1$ and $\varepsilon_2$ obtained before and the modulus ratio $k_E = E_1/E_2$.  **6 M**

5. a) Deduce transformation relations for elastic constant, $E_x$ in terms of engineering constants $(E_1, E_2, G_{12}, \nu_{12} \text{ and } \nu_{21})$.  **8 M**

   b) Explain Tsai-Hill failure mechanism of laminated composites.  **6 M**

6. a) Explain the effect of fiber volume fraction and the modulus of fibers on Young's modulus of composite lamina.  **7 M**

   b) Discuss the influence of change in temperature on unidirectional composites.  **7 M**

7. Compute all terms of extensional stiffness matrix, coupling stiffness matrix and bending stiffness matrix for a $[0/90]$ laminate with the following lamina properties.

$E_1 = 145 GPa$ ; $E_2 = 105 GPa$ ; $G_{12} = 7.5 GPa$; $v_{12} = 0.28$ ; lamina thickness: $t = 0.25\ mm$         14 M

8. a) Discuss the three different types of failures of a laminated composite.       6 M

   b) Explain the general design methodology for a structural composite material.       8 M