Registration No. : | | | | | | | | | | |

*Total number of printed pages – 2*

**B. Tech**
**PEMT 5305**

## Sixth Semester Regular Examination – 2015

# COMPOSITE MATERIALS

## BRANCH : MME

### QUESTION CODE : J 471

**Full Marks – 70**

**Time : 3 Hours**



*Answer Question No. **1** which is compulsory and any **five** from the rest.*
*The figures in the right-hand margin indicate marks.*

1. Answer the following questions : 2 ×10

(a) Differentiate between cermets and SAP type materials.

(b) Draw the force displacement curve of pulling a fiber out of the matrix and explain how the fiber pull-out and debonding improve the toughness.

(c) For a fiber reinforced composite that is subjected to a tensile stress equal to the fiber tensile strength $\sigma_f$ draw and explain the stress position profiles in the fiber for three possibilities of fiber lengths (i) $l < l_c$ (ii) $l = l_c$ (iii) $l > l_c$ where, $l_c$ is the critical fiber length.

(d) What is function of the core and the face in sandwich panels ?

(e) A thermoplastic matrix contains 40 wt. % glass fiber. If the density of the matrix $\rho_m$ is 1.1 g $cm^{-3}$ while that of glass fiber, $\rho_f$, is 2.5 g $cm^{-3}$, what is the density of the composite? Assume that no voids are present.

(f) What is wake toughening ?

(g) With a suitable diagram explain the chemical vapor infiltration (CVI) process.

(h) Describe the characteristic features of aramid fibers.

(i) What is glass transition temperature ? How is it different from melting temperature ?

(j) A continuous and aligned glass-reinforced composite consists of 40 vol% of glass fibres having a modulus of elasticity of 69 x $10^3$ MPa and 60 vol% of a polyester resin that, when hardened, has a modulus of 3.4 x $10^3$ MPa. Calculate the modulus of elasticity of this composite.

**P.T.O.**

2. Explain the different fabrication processes and mechanical properties of dense carbon-carbon composites 10

3. A continuous and aligned fibrous reinforced composite having a cross-sectional area of 970 $mm^2$ is subjected to an external tensile load. If the stresses sustained by the fiber and the matrix phases are 215 MPa and 5.38 MPa respectively, the force sustained by the fiber phase is 76,800N, and the total longitudinal composite strain is $1.56 \times 10^{-3}$, then determine
   (i) The force sustained by the matrix phase.
   (ii) The modulus of elasticity of the composite material in the longitudinal direction and
   (iii) The moduli of elasticity for fiber and matrix phases. 10



4. (a) Describe the filament winding process of fabricating continuous fiber reinforced composites and give the advantages and limitations of the process. 5
   (b) What are the different liquid state processes for the production of MMCs and explain the liquid melt infiltration under gas pressure technique with suitable diagrams ? 5

5. (a) What is a prepreg ? Draw the schematic diagram of a prepreg. Explain the different techniques by which prepregs can be made. And explain the Auto-clave process to make a laminated composite. 5
   (b) Name the different methods for processing of CMCs and explain the different vapour deposition techniques. 5

6. (a) Calculate the longitudinal tensile strength and longitudinal modulus of elasticity for a continuous and aligned fibre reinforced composite consisting of 45 vol% aramid fibres and 55 vol% of a polycarbonate matrix having the following parameters : $E_f = 1.3 \times 10^5$ MPa, $E_m = 2.4 \times 10^3$ Mpa, $\sigma_f = 3500$ MPa, and $\sigma_m = 55$ MPa. 5
   (b) Compare and explain the typical stress – strain curves of fibre – reinforced CMC with that of particulate – reinforced CMC and monolithic ceramic. 5

7. (a) Derive an expression for the modulus of elasticity for a continuous and aligned fibrous composite loaded in the direction of alignment ? 5
   (b) Explain with suitable sketches the filament winding method of producing polymer matrix composites. 5

8. Write short notes on any **two** : 5 × 2
   (a) Transformation Toughening.
   (b) Multifilamentary superconductors.
   (c) Injection Moulding.
   (d) Rheocasting.