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SEVENTH SEMESTER **B.Tech (P/T)**

SUPPLEMENTARY EXAMINATION **FEB 2019**

CME-413 Composite Material Technology

Time: 3:00 Hour **Max. Marks: 40**

Note: 1. Attempt any five questions.
2. Assume missing data, if any

Q-1 (a) Differentiate between: [4]

(i) Micromechanics and Micromechanics
(ii) Lamina and Laminate

(b) Describe one manufacturing method of polymer matrix composite. [4]

Q-2 (a). Derive the expression of in –plane Shear modulus and transverse Young's modulus for unidirectional loaded lamina. [4]

(b) A lamina consists of 100 fibers of 10 μm diameter. The fibers are 10 mm long. Find the interfacial area. What is increase in interfacial area if the diameter of fiber reduced to 5 μm and total volume of fiber is kept constant. [4]

Q-3(a) What types of processes are used for recycling of composites. Explain in detail. [4]

(b) A glass/epoxy lamina with a 60% fiber volume fraction. Use the properties of glass and epoxy from Table-1. Determine the [4]

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(i) Mass fraction of glass and epoxy
(ii) Volume of composite lamina if the mass of lamina is 4 kg.

Table-1 Properties of Glass and Epoxy

Property	Units	Glass	Epoxy
Axial modulus	GPa	85	3.4
Transverse modulus	GPa	85	3.4
Axial Poisson's ratio	—	0.20	0.30
Transverse Poisson's ratio	—	0.20	0.30
Axial shear modulus	GPa	35.42	1.308
Axial coefficient of thermal expansion	μm/m/°C	5	63
Transverse coefficient of thermal expansion	μm/m/°C	5	0.33
Axial tensile strength	MPa	1550	72
Axial compressive strength	MPa	1550	102
Transverse tensile strength	MPa	1550	72
Transverse compressive strength	MPa	1550	102
Shear strength	MPa	35	34
Specific gravity	—	2.5	1.2

Q-4 (a) Describe in detail the typical application of polymer matrix composites. [4]

(b) The reduced stiffness matrix [Q] is given for a unidirectional lamina is given as follows [4]

$$[Q]=\begin{bmatrix} 5.681 & 0.3164 & 0 \\ 0.3164 & 1.217 & 0 \\ 0 & 0 & 0.6006 \end{bmatrix} Msi$$

What are the four engineering constants, $E1$, $E2$, $\nu 12$, and $G12$, of the lamina.

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Q-5 (a) Explain the method of manufacturing of prepregs schematic diagram. [4]

(b) Find the compliance matrix for a graphite/epoxy lamina. The material properties are given as [4]

Young's modulus:
$E1 = 190\ GPa$; $E2 = 11.3\ GPa$; $E3 = 10.3\ GPa$

Poisson's ratio
$\nu 12 = 0.3$; $\nu 23 = 0.80$; $\nu 13 = 0.27$

Shear modulus:
$G12 = 8.17\ GPa$; $G23 = 3.5\ GPa$; $G31 = 7.5\ GPa$

Q-6 (a) Find the relationship between the engineering constants of a three-dimensional orthotropic material and its compliance matrix. [4]

(b) A displacement field in a body is given by [4]

$u=10^{-5}(x^2+6y+7xy)$

$v=10^{-5}(yz)$

$w=10^{-5}(xy+yz^2)$

Find the state of strain at (x, y, z) =(1,2,3)

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