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December 2023 (ENDSEM) EXAM

T.Y. B.TECH (SEMESTER - I)

COURSE NAME: COMPOSITE MATERIALS Branch: Mechanical COURSE CODE: MEUA31205B

(PATTERN 2020)

Time: [1Hr. 30 Min] **[Max. Marks: 40]**

(*) Instructions to candidates:

1) **Figures to the right indicate full marks.**
2) **Use of scientific calculator is allowed**
3) **Use suitable data wherever required**
4) **All questions are compulsory. Solve any one sub question from Question 3 and any two sub questions each from Questions 4,5 and 6 respectively.**

Q. No.	Question Description	Max. Marks	CO mapped	BT Level
Q.1	a) Illustrate the following composite material terminology: Interply hybrid laminates, Intraply hybrid composites, orthotropic material, Prepregs	[2]	1	Understand
Q.2	a) Discuss the function of mandrel in filament winding and its types.	[2]	2	Understand
Q.3	a) Illustrate In-plane shear test as per ASTM standard with neat sketch with respect to ASTM standards used, specimen dimensions with sketch, failure modes and acceptable failure patterns.	[6]	3	Understand
	b) Illustrate compression test as per ASTM standard with neat sketch with respect to ASTM standards used, specimen dimensions with sketch, failure modes and acceptable failure patterns.	[6]	3	Understand
Q.4	a) Proove the expression $\frac{1}{G_{12}} = \frac{V_f}{G_f} + \frac{V_m}{G_m}$ for in-plane shear modulus of composite laminate in terms of volume fraction and shear modulus of fiber and matrix based on strength of material approach.	[5]	4	Apply
	b) Calculate longitudinal modulus and tensile strength of UD composite containing 65% kevlar fibers by volume in epoxy resin. Given: Modulus and strength of carbon fiber is 194 GPa and 4.6 GPa respectively. Modulus and strength of epoxy-based matrix is 3.5 GPa and 100 MPa respectively.	[5]	4	Apply
	c) Longitudinal modulus of glass reinforced lamina is to be doubled by substituting some of the glass fibers with kevlar fibers. The total fiber volume (kevlar+glass) remains unchanged at 0.5 Calculate volume fraction of kevlar fibers. Given E_{kevlar} = 220 GPa , E_{glass} = 75 GPa , E_{matrix} = 5.5 GPa	[5]	4	Apply

Q.5	a) Formulate the stress-strain relation for two-dimensional orthotropic lamina in terms of both stiffness and compliance matrix. Also obtain the relations for each constant of stiffness and compliance matrix.	[5]	5	Apply
	b) For the Graphite epoxy UD orthotropic lamina, Determine reduced stiffness matrix $[Q]$ and compliance matrix $[S]$. Given E_1= 150 GPa, E_2 = 20 GPa, $\nu_{12} = 0.20$, $G_{12} = 5\ GPa$	[5]	5	Apply
	c) For a given reduced stiffness matrix [Q] , calculate the transformed reduced stiffness matrix $[\bar{Q}]$ at 60° $$[Q] = \begin{bmatrix} 30 & 1.4 & 0 \\ 1.4 & 5 & 0 \\ 0 & 0 & 0.7 \end{bmatrix} GPa$$	[5]	5	Apply
Q.6	a) Formulate the laminate codes for different cases (at least 5) with suitable example.	[5]	6	Apply
	b) A [+45/-45/-45/+45] symmetric laminate subjected to $N_y = 10$ and with extensional stiffness matrix $[A]$ given as $$[A] = \begin{bmatrix} 187 & 4.34 & 0 \\ 4.34 & 101 & 0 \\ 0 & 0 & 10.7 \end{bmatrix}$$ Estimate the midplane strains.	[5]	6	Apply
	c) Evaluate extensional stiffness matrix [A] matrix for a three-ply [$0/\overline{90}$]s laminate . Transformed reduced stiffness matrix $[\bar{Q}]$ for 0° and 90° are given below. Each lamina is 0.003 thick. $$[\bar{Q}]_0 = \begin{bmatrix} 24 & 4 & 0 \\ 4 & 15 & 0 \\ 0 & 0 & 9 \end{bmatrix} \qquad [\bar{Q}]_{90} = \begin{bmatrix} 15 & 4 & 0 \\ 4 & 24 & 0 \\ 0 & 0 & 9 \end{bmatrix}$$	[5]	6	Apply