

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2018****Subject Code: 2170107****Date: 26/11/2018****Subject Name: Mechanics of Composite Materials****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) What is composite material? List the types of reinforcement used in a composite.	03
	(b) Explain the mechanical behavior of composites.	04
	(c) Differentiate between Micromechanics and Macromechanics. Also mention the assumptions made in typical Micromechanical analysis.	07
Q.2	(a) Explain the use of composite materials in Aircraft industry	03
	(b) Define Poisson's ratio and derive the rule of mixtures for major Poisson's ratio.	04
	(c) Using strength of material approach to derive the relation for transverse modulus of a unidirectional composite. Also write Halpin-Tsai relations for evaluation of transverse modulus	07
	OR	
	(c) Explain in detail Symmetric laminates	07
Q.3	(a) Differentiate between Lamina and Laminate with neat sketches	03
	(b) Derive an expression for density of a unidirectional composite lamina in terms of densities of its constituents.	04
	(c) Explain in detail Anti-Symmetric laminates	07
	OR	
Q.3	(a) Explain the purpose of prepegs and fillers in composite materials	03
	(b) Give classification of laminate configuration	04
	(c) Find the minor and major Poisson's ratio of a Glass/Epoxy lamina with a 70 percent fibre volume fraction. Use $\nu_{12f} = 0.2$ $\nu_m = 0.3$ $E_f = 85\text{GPa}$ and $E_m = 3.4\text{ GPa}$	07
Q.4	(a) Write the disadvantages of composite material.	03
	(b) Determine the reduced Stiffness matrix [Q] for an orthotropic lamina with the following material properties. $E_1 = 150\text{ GPa}$, $E_2 = 20\text{ GPa}$, $G_{12} = 5\text{ GPa}$ and $\nu_{12} = 0.3$	04
	(c) The longitudinal modulus of a Glass Reinforced Plastic (GRP) lamina is to be doubled by substituting some of the glass fibres with carbon fibres. The total fibre volume remains unchanged at 0.5. Calculate the fraction of carbon fibres. Use $E_{\text{carbon}} = 300\text{ GPa}$, $E_g = 70\text{ GPa}$ and $E_m = 5\text{ GPa}$	07
	OR	
Q.4	(a) Discuss the role of fibres and matrix in composite material	03

- (b) Identify the following types of laminate: 04
 i. $[0|90_2|0|90]$
 ii. $[-45|45|-45|45]$
 iii. $[0|90]_s$
 iv. $[-45|0|45|90]_s$
- (c) Derive the stress-strain relationship for a specially orthotropic composite material. 07
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- Q.5** (a) Sketch the variation of stress and strain in a laminate 03
 (b) Calculate the longitudinal modulus and tensile strength of a unidirectional composite containing 60 percent by volume fraction of carbon fibres. Use $E_{1f} = 3.6$ GPa and $\sigma_{mu} = 105$ MPa. Compare these values with experimentally determined values of $E_1 = 162$ GPa and $\sigma_{mu} = 2.94$ GPa. What fraction of the load is carried by the fibres in the composite? 04
 (c) Stating the necessary assumptions made in laminate theory, derive the strain displacement relation for a laminate. 07
- OR**
- Q.5** (a) List the four elastic moduli of unidirectional lamina. Also list the different methods used to determine them. 03
 (b) Derive the relation for inplane shear modulus using the strength of material approach. 04
 (c) Calculate the matrices $[A]$ and $[B]$ for a cross-ply laminate $[0|90]$ with the following lamina properties. $E_1 = 140$ GPa, $E_2 = 10$ GPa, $E_6 = 5$ GPa, $\nu_{12} = 0.3$. Use ply thickness, $d = 0.125$ mm 07
