Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER 2013

Subject Code: 170103 **Date: 28-05-2013**

Subject Name: Mechanics of Composite Materials

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** Sketch the variation of stress, strain and deformation in a laminate. Explain in detail stress resultants and their importance. Maximize the use of relevant sketches. **07**

(b) Write a detailed explanation on symmetric laminates and its classification with sufficient examples for each classification **07**

Q.2 **(a)** A 0 degree unidirectional lamina and a 45 degree unidirectional lamina are joined together, side by side. Tensile stress is applied to this specimen. (Inclination is w.r.t loading axis). Following are the properties of bote the laminae: E1=145 GPa, E2= 10.45 GPa, **07**

E6= 6.9 GPa and v12=0.28, Ex=16.42 GPa, vxy=0.189

Do the following:

1. Evaluate the strains
2. Sketch the deformed specimen

(b) Mention the range of E1, E2 and v12, normally found in uni-directional plies. Plot the variation of Young's modulus, Shear modulus and Poisson's ratio w.r.t the orientation angle. "Give definite reasons" for this pattern of variation. **07**

OR

(b) Calculate the [A], [B] and [D] matrices for [+45|-45] laminate having a thickness of 0.125 mm each. **07**

$$[Q_{xy}]^{45} = \begin{matrix} 44.25 & 34.25 & 32.70 \\ 34.25 & 44.25 & 32.70 \\ 32.70 & 32.70 & 36.23 \end{matrix}$$

Q.3 **(a)** A $[+45|-45]_S$ symmetric laminate is subjected to Nx=100 MPa-mm. The material properties are E1=140 GPa, E2=10 GPa, E6=5 GPa, v12=0.3, d=0.25mm. Determine the resulting stresses along the reference axis for each lamina. For the [+45|-45|-45|45] lamina following are the stiffness matrices: **07**

$$[A] = \begin{matrix} 44.25 & 34.25 & 0 \\ 34.25 & 44.25 & 0 \\ 0 & 0 & 36.25 \end{matrix} \text{ (GPa-mm)} \qquad [D] = \begin{matrix} 3.69 & 2.85 & 0 \\ 2.85 & 3.69 & 0 \\ 0 & 0 & 3.02 \end{matrix} \text{ (GPa-mm)}$$

(b) Write a short note on coupling effects in detail, with relevant sketches **07**

OR

Q.3 **(a)** A cross ply laminate $[0|90]_S$ made from high strength carbon/epoxy unidirectional plies and subjected to a tensile membrane longitudinal force of Nx = 100N/m. Each ply is 0.125 mm thick and have identical properties. E1=140 GPa, E2=10 GPa, E6=5 GPa, v12=0.3 Calculate the stresses in the principal material direction **07**

(b) Write a short note on Balanced laminates and Anti-symmetric laminates along with its classification **07**

Q.4 **(a)** Define micromechanical analysis and macro-mechanical analysis and write a short note on derivation of longitudinal strength and stiffness **07**

	(b)	A glass/epoxy specimen weighing 0.98 gm was burnt and the weight of the remaining fibres was found to be 0.49 gm. Densities of glass and epoxy are 2.4 gm/ml and 1.20 gm/ml respectively. Determine the density of composites in the absence of voids. If the actual density of the composite was measured to be 1.50 gm/ml, what is the void fraction?	**07**
		OR	
Q.4	**(a)**	Explain in detail volume and weight fractions and write a short note on derivation of transverse modulus	**07**
	(b)	Write a short note on stress-strain relationship, define stiffness and compliance. Write stress-strain relationships for Monoclinic, Specially Orthotropic, Transversely isotropic and isotropic material	**07**
Q.5	**(a)**	Write a short note on micromechanics of failure of unidirectional lamina including Longitudinal tension	**07**
	(b)	What is a failure envelope? What does failure theory do? Explain Maximum stress theory and compare it with other criteria using failure envelopes	**07**
		OR	
Q.5	**(a)**	Write a short note on micromechanics of failure of unidirectional lamina including Longitudinal compression	**07**
	(b)	Explain Maximum strain and Tsai-Hill stress criteria, draw their failure envelopes as well.	**07**

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