

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 both the laminae: $E_1=145$ GPa, $E_2=10.45$ GPa, $E_6=6.9$ GPa and $\nu_{12}=0.28$, $E_x=16.42$ GPa, $\nu_{xy}=0.189$. Do the following: **07**

1. Evaluate the strains
2. Sketch the deformed specimen

- (b) Mention the range of E_1 , E_2 and ν_{12} , 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. $[Q_{xy}]^{45} = \begin{bmatrix} 44.25 & 34.25 & 32.70 \\ 34.25 & 44.25 & 32.70 \\ 32.70 & 32.70 & 36.23 \end{bmatrix}$ **07**

- Q.3** (a) A $[+45|-45]_s$ symmetric laminate is subjected to $N_x=100$ MPa-mm. The material properties are $E_1=140$ GPa, $E_2=10$ GPa, $E_6=5$ GPa, $\nu_{12}=0.3$, $d=0.25$ mm. Determine the resulting stresses along the reference axis for each lamina. For the $[+45|-45|-45|45]$ lamina following are the stiffness matrices: **07**

$$[A] = \begin{bmatrix} 44.25 & 34.25 & 0 \\ 34.25 & 44.25 & 0 \\ 0 & 0 & 36.25 \end{bmatrix} \quad [D] = \begin{bmatrix} 3.69 & 2.85 & 0 \\ 2.85 & 3.69 & 0 \\ 0 & 0 & 3.02 \end{bmatrix}$$

(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 $N_x = 100$ N/m. Each ply is 0.125 mm thick and have identical properties. $E_1=140$ GPa, $E_2=10$ GPa, $E_6=5$ GPa, $\nu_{12}=0.3$. 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**
