GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: 170103   **Date: 04-12-2014**

Subject Name: Mechanics of Composite Materials

Time: 10:30 am - 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.**

Q.1 **(a)** Derive longitudinal strength of a lamina.   **07**

(b) Compute [A], [B], and [D] matrices for a [-60l0l+60] laminate. Material **07** properties of the laminate are E_1=140 GPa, E_2=10 GPa, E_6=6 GPa, $\upsilon_{12} = 0.3$ and thickness = 0.2 mm. Define the type of laminate. Draw the sketch of the laminate showing the height co-ordinates of top and bottom of each ply.

Q.2 **(a)** If the Reduced Stiffness Matrix of a material is given by: **07**

$$[Q]=\begin{bmatrix} 150.81 & 4.027 & 0 \\ 4.027 & 20.11 & 0 \\ 0 & 0 & 5 \end{bmatrix} GPa$$

Determine E_1, E_2, G_{12} and υ_{12} of the orthotropic lamina. How many planes of symmetry and independent elastic constant does an orthotropic material have?

(b) Explain strain-displacement relationship of a laminate. Draw relevant sketches.   **07**

OR

(b) Write short note on: **07**
   1. Differentiate between the structural behavior of isotropic materials and fibre reinforced composites.
   2. Sketch the variation of Young's modulus: Ex and Ey with θ and explain the reason of variation.

Q.3 **(a)** Derive the laminate stiffness; [A], [B] and [D]. Start from inplane forces and **07** moments of a laminate.

(b) Define on-axis and off-axis lamina. Describe the need of transformation in a fibre **07** reinforced laminate. Explain what would happen if without performing transformation stresses are calculated for a [90l0l90] laminate.

OR

Q.3 **(a)** Explain the stress and strain relations in a laminate and also explain and sketch **07** the variation of stress and strain through a laminate.

(b) Describe in detail [A], [B] and [D] matrices, identify the couplings clearly.   **07**

Q.4 **(a)**
   1. A 45 degree lamina has stresses as mentioned below along the reference **07** axes; determine the equivalent stress system of lamina along material axes 1 and 2. $\sigma_x = 200\,GPa$, $\sigma_y = 50\,GPa$, $\sigma_s = 70\,GPa$

   2. An isotropic lamina has E=100 kN/m^2 and υ=0.25. Determine the reduced stiffness matrix and reduced compliance matrix.

(b) Explain the failure of unidirectional lamina under longitudinal tension.   **07**

OR

Q.4 **(a)** 1. Determine the strain along the material axis 1-2 for a 30 degree lamina. **07**
The strains along the reference axes are $\varepsilon_x = 0.002$, $\varepsilon_y = 0.0015$,
$\varepsilon_s = 0.00008$

2. Define stiffness and compliance matrices.

(b) Explain Maximum Stress theory **07**

Q.5 **(a)** Write a short note on symmetric laminates **07**

(b) Compute the [A] matrix for a [-0|45|-45|+90]s. Thickness of each ply is 0.25 **07**
mm. E1=140GPa, E2=10GPa, E6=5GPa and $\upsilon_{12} = 0.3$

OR

Q.5 **(a)** Write a short note on anti-symmetric laminates **07**

(b) Write a short note on the elastic properties of different kind of materials. Also **07**
mention the number of independent elastic constants and planes of symmetry
each of them have.

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