Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VII Examination-Nov/Dec.-2011

Subject code: 170103 **Date: 24/11/2011**

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)** Describe laminate stiffness and derive stress resultants in terms of laminate stiffness. Explain the significance of each term. **07**

(b) [Q] matrix for a 0^0 Boron-Epoxy ply is $Q = \begin{bmatrix} 300 & 10 & 0 \\ 10 & 300 & 0 \\ 0 & 0 & 10 \end{bmatrix}$ GPa. Ply arrangement is $0^0_{0.2mm}|45^0_{0.1mm.}$ Evaluate [A], [B] and [D] matrices **07**

Q.2 **(a)** State and Justify whether true or false **07**

1. Cylindrical fibres can be packed upto 98% of the volume fraction of the composite
2. Stress bearing capacity of a composite is higher than that of fibre
3. Transverse modulus is highly dependent on matrix modulus and Poisson's ratio of matrix
4. Quasi-isotropic plies consist of generally orthotropic plies
5. Compliance matrix is symmetric
6. When cracks are introduced in composites, stiffness of composite increases
7. $-\theta_1|\theta|-\theta_1$ is an anti-symmetric laminate

(b) Derive strain-displacement relationship in detail and also explain the significance of each term with a neat sketch **07**

OR

(b) Define "reduced" compliance and stiffness. How are Compliance and Stiffness matrix related? What is their physical significance? Write these matrices for a unidirectional lamina **07**

Q.3 **(a)** [Q] matrix for a 0^0 ply is $Q = \begin{bmatrix} 140.9 & 3.01 & 0 \\ 3.01 & 10.06 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ GPa. Ply arrangement is $0^0|90^0$. Evaluate [A], [B] and [D] matrices. Ply thickness = 0.125 mm **07**

(b) Explain transformation of stress and strain in detail **07**

OR

Q.3 **(a)** A uni-directional lamina is subjected to stresses as follows σ_1=500 MPa, σ_2=80 MPa and σ_6=25 MPa. E= 100 kN/mm^2 and ν = 0.25. Determine reduced stiffness, reduced compliance matrix and the strain components. **07**

(b) Uni-axial force of 100 MPa-mm is applied to a symmetric cross-ply laminate $[0|90]_S$. Thickness of each ply = 0.125 mm. $Q = \begin{bmatrix} 140.9 & 3.01 & 0 \\ 3.01 & 10.06 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ GPa and $[A]^{-1} = \begin{bmatrix} 0.0265 & -0.0011 & 0 \\ -0.0011 & 0.0265 & 0 \\ 0 & 0 & 0.4 \end{bmatrix}$ mm/GPa **07**

Calculate the stresses in this lamina in the principal material direction

Q.4 **(a)** Explain micromechanical analysis of composite materials in general. Describe and derive volume and weight fractions for a composite material. **07**

(b) Describe and derive inplane shear modulus and Poisson's ratio for a composite material from micro-mechanical point of view in detail **07**

OR

Q.4 **(a)** State assumptions and limitations considered for arriving at a micro-mechanical solution. Derive and explain transverse modulus for a composite material from micro-mechanical point of view in detail **07**

(b) Define composite materials, justify their need in the industry, areas of applications and give examples of fibres and matrix commonly used along with their important mechanical properties. **07**

Q.5 **(a)** Explain the behavior of a composite material under longitudinal compression, also explain the prediction of its strength and describe failure mechanism. **07**

(b) Explain in detail symmetric laminates "with" isotropic plies and specially orthotropic plies **07**

OR

Q.5 **(a)** Describe the significance of [A], [B] and [D] matrices and explain clearly how all plies of a given composite material are accounted for in these matrices. Give example. **07**

(b) Define and describe laminate, uni-directional laminate, FRP and justify the use of FRP in industry. **07**

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