

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII(NEW) EXAMINATION – SUMMER 2019

Subject Code:2170107

Date:16/05/2019

Subject Name:Mechanics of Composite Materials

Time:02:30 PM TO 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.

		MARKS
Q.1	(a) What is the limitation of a unidirectional lamina? How it can be overcome by laminate? Explain with neat sketch.	03
	(b) Define composite material. Explain basic constituent materials of composites	04
	(c) Carry out the comparison of composite material with metals in detail.	07
Q.2	(a) Draw a neat sketch of variation of stress and strain through the thickness of the laminate.	03
	(b) The E-glass fibres in a polyester resin is 35% by weight. Given $\rho_f = 2.50$ g/ml and $\rho_m = 1$ g/ml. Calculate V_f and ρ_c for the lamina.	04
	(c) Identify the types of laminate given below.	07
	1. $[0/30/60]_s$	
	2. $[0/90_2/0/90]$	
	3. $[-40/40/-40/40]$	
	4. $[45/60/-60/-45]$	
	5. $[30/40/-30/30/-30/-40]$	
	6. $[0/\pm 60]$	
	7. $[0/90]_s$	
	OR	
	(c) Evaluate the transverse modulus E_2 of a composite lamina by (i) strength of material approach and (ii) Halpin-Tsai relation, with the following properties $E_{2f} = 14.8$ GPa, $E_m = 3.45$ GPa, $\nu_m = 0.36$, $V_f = 0.65$. Assume $\xi_1 = 1$.	07
Q.3	(a) Explain about symmetric laminate.	03
	(b) Derive the equation of Inplane Shear modulus using neat sketches.	04
	(c) Derive Strain-Displacement relationship of a laminate using a neat sketch.	07
	OR	
Q.3	(a) What do you mean by balanced laminate.	03
	(b) Derive the equation of Transverse modulus with the use of neat sketches.	04
	(c) Write down [A], [B] and [D] matrices and explain its significance in detail.	07
Q.4	(a) Write down the difference between micromechanics and macromechanics.	03

- (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. **04**
- (c) Discuss the application of composite materials in various engineering fields. **07**
- OR**
- Q.4** (a) Explain about prepegs. **03**
- (b) Derive the rule of mixtures relation for major Poisson's ratio and write expression for minor Poisson's ratio. **04**
- (c) Write down the advantages and disadvantages of composite material. **07**
- Q.5** (a) Reduced stiffness matrix of an orthotropic lamina is given by, **03**
- $$[Q] = \begin{bmatrix} 150.81 & 4.027 & 0 \\ 4.027 & 20.11 & 0 \\ 0 & 0 & 5 \end{bmatrix} \text{ GPa}$$
- Determine E_1 , E_2 , G_{12} and ν_{12} .
- (b) Explain the classification of composite materials in detail. **04**
- (c) How the independent elastic constants have been reduced from 81 to 2 for different materials. Explain in detail with the use of stress-strain relations and neat sketches. **07**
- OR**
- Q.5** (a) For an orthotropic lamina, engineering constants along the principal material axis are $E_1 = 150 \text{ GPa}$, $E_2 = 20 \text{ GPa}$, $G_{12} = 5 \text{ GPa}$, $\nu_{12} = 0.2$. Determine the reduced stiffness matrix $[Q]$. **03**
- (b) Write down the significance of fillers and additives in composite materials in detail. **04**
- (c) Anisotropic lamina has $E = 100 \text{ kN/mm}^2$ and $\nu = 0.25$. Determine reduced stiffness matrix and reduced compliance matrix. **07**
