Total No. of Questions – [06] Total No. of Printed Pages: 2

G.R. No.	

DECEMBER 2021 - ENDSEM EXAM
T.Y.B.TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)
COURSE NAME: COMPOSITE MATERIAL
COURSE CODE: MEUA31183B
(PATTERN 2018)

Time: [1 Hour] [Max. Marks: 30]

(*) Instructions to candidates:

1) **Answer Q.1 OR Q.2, Q.3 OR Q.4, Q.5 OR Q.6.**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q.1) a) Evaluate longitudinal modulus and tensile strength of unidirectional composite laminate containing 60% carbon fiber by volume. Given: Modulus of carbon fiber = 294 GPa, Tensile strength of carbon fiber=5.6 GPa, Modulus of Epoxy = 3.6 GPa, Tensile strength of epoxy = 105 MPa. **[4 marks]**

b) Derive the expression for poisons ratio relating volume fraction of fiber and matrix using strength of material approach. **[6 marks]**

OR

Q.2) a) Find the transverse young's modulus of glass-epoxy lamina with fiber volume fraction 60%. Modulus of glass fiber is 95 GPa, Modulus of epoxy is 3.6 GPa. **[4 marks]**

b) Derive the expression for in plane shear modulus relating volume fraction of fiber and matrix using strength of material approach. **[6 marks]**

Q.3) a) Determine the equivalent stress system along the global coordinates if stresses along material axis (local coordinate) 1-2 for lamina with ply angle 45^0 are **[4 marks]**

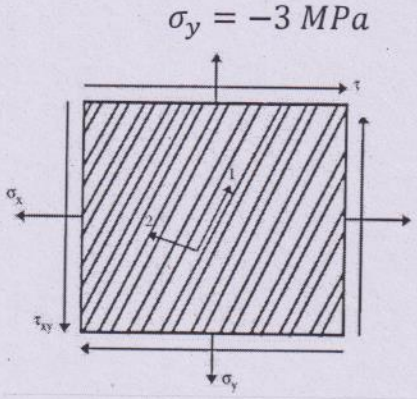
$$\sigma_1 = 195\ MPa, \sigma_2 = 55\ MPa, \tau_{12} = -75\ MPa$$

b) For a given [Q] , calculate the $[\bar{Q}]$ at 90^o **[6 marks]**

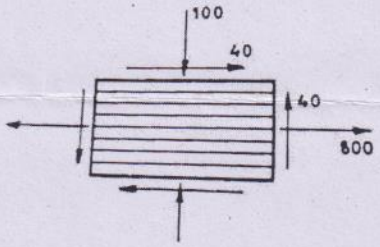
$$[Q] = \begin{bmatrix} 30 & 1.4 & 0 \\ 1.4 & 5 & 0 \\ 0 & 0 & 0.7 \end{bmatrix} GPa$$

OR

Q.4) a) Find local stresses for a 45° angle lamina of graphite/epoxy **[4 marks]**



b) A carbon epoxy unidirectional lamina is subjected to a stress system as shown in Figure (stress are N/mm²). The ply properties are **[6 marks]**



E_1=150 kN/mm², E_2 = 12 kN/mm², G_{12} = 7 kN/mm², ν_{12} =0.2, X_t = 1550 N/mm², X_c = 1150 N/mm² , Y_t = 60 N/mm², Y_c = 240 N/mm², S= 75 N/mm²

X_c & Y_c are compressive. For Tsai-Wu failure theory, evaluate the coefficients F_1, F_2 and F_{12}

Q.5) a) Find [A] matrix for a three-ply $[0/\overline{90}]s$ laminate . Transformed reduced stiffness matrix for 0^0 and 90^0 are given below. Each lamina is 0.003 m thick. **[4 marks]**

$$[\bar{Q}]_0 = \begin{bmatrix} 24 & 4 & 0 \\ 4 & 15 & 0 \\ 0 & 0 & 9 \end{bmatrix} \qquad [\bar{Q}]_{90} = \begin{bmatrix} 15 & 4 & 0 \\ 4 & 24 & 0 \\ 0 & 0 & 9 \end{bmatrix}$$

b) A thick laminate with thickness 0.10 m is subjected to in-plane loads. The midplane strains and curvatures are given as follows. Calculate global strains at the top surface of the laminate. **[6 marks]**

$$\begin{Bmatrix} \epsilon_x^0 \\ \epsilon_y^0 \\ \gamma_{xy}^0 \end{Bmatrix} = \begin{Bmatrix} 2651 \\ -1231 \\ -1025 \end{Bmatrix} \times 10^{-6}, \quad \begin{Bmatrix} k_x \\ k_y \\ k_{xy} \end{Bmatrix} = \begin{Bmatrix} 1.965 \\ 0.2285 \\ -1.673 \end{Bmatrix}$$

OR

Q.6) a) Elaborate two Special Cases of Laminates with designation **[4 marks]**

b) A [+45/-45/-45/+45] symmetric laminate subjected to $N_x = 100$ and extensional stiffness matrix is given as below. Evaluate midplane strains.

$$[A] = \begin{bmatrix} 187 & 4.34 & 0 \\ 4.34 & 101 & 0 \\ 0 & 0 & 10.7 \end{bmatrix}$$