

- Applied Mechanics Department**
Major Exam- AML835-Mechanics of composite materials
6 May 2023. Duration: 140 Min. Max Marks: 100
- 1 a) Explain Anisotropic, Cross ply, Classical orthotropic, and Angle ply laminated plates and their construction. **8 marks**
 b) What is the difference between the special orthotropic and anisotropic materials in macro-mechanics relations for 2D stiffness matrix. Discuss **9 marks**
- 2 a) Discuss the first ply failure effect. What you understand by failure envelope. Give an Example for one type of failure criteria. **9 marks**
 b) Determine the maximum value of $a > 0$, if stresses of $\sigma_x = 3a$, $\sigma_y = -2a$ and $\tau_{xy} = 5a$ are applied to a 60° lamina of graphite/epoxy. The material properties of this lamina are given as follows: $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $\nu_{12} = 0.28$, $G_{12} = 7.17$ GPa, $X_t = 1500$ MPa, $X_c = 1500$ MPa, $Y_t = 40$ MPa, $Y_c = 246$ MPa, $S = 68$ MPa. Use maximum stress failure theory and Tsai – Wu failure theory. Compare the results **15 marks**
- 3 a) What are the types of laminates given below? **6 marks**
 (i) $[30/-45/-30/45]$, (ii) $[0/90/0/90]$, (iii) $[0/45/90/-45]$
 b) Calculate the residual stresses at the bottom surface of the 0° ply in a two ply $[0^\circ]_2$ glass/epoxy laminate subjected to a temperature change of -55°C . The properties of each lamina are as: $E_1 = 38.6$ GPa, $E_2 = 8.27$ GPa, $G_{12} = 4.14$ GPa, $\nu_{12} = 0.26$, $\alpha_1 = 8.6 \times 10^{-6}$ m/m/ $^\circ\text{C}$, $\alpha_2 = 22.1 \times 10^{-6}$ m/m/ $^\circ\text{C}$, and thickness of each layer is 5 mm. **15 marks**
- 4 Write completely with figure regarding the manufacturing process of Resin Transfer Molding for manufacturing fiber composites. What are the applications and advantages and disadvantages of this process? **14 marks**
- 5 a) Explain basic assumptions made in the classical laminate theory. What are the contradictions? **4 marks**
 b) Define ABD Matrices. How matrix D can be simplified? **5 marks**
 c) Consider that the clip as shown in the figure is made of unidirectional fiber composite with the following properties. The compressive force at points B and C of the clamp is 1.5 KPa, and the ED screw can withstand only tensile force. The cross-sectional dimensions are shown at point F on the cross-sectional plane A-A. Calculate the strains and stresses in the principal axis of the fibers. Area 0.75×0.75 squared inches **15 marks**

