Hall Ticket Number:

Code No. : 22856

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

M.E. (Mech. Engg.) II-Semester Main Examinations, September-2022

Mechanics of Composite Materials (PE-IV)

(Advanced Design & Manufacturing)

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10× 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	What factors influence the mechanical performance of a composite other than the fiber and the matrix?	2	1	1	3
2.	Summarize the description of the glass fiber	2	1	1	3
3.	List the Halpin-Tsai expression for in plane shear modulus of uni-directional (UD) lamina.	2	1	2	3
4.	List the expressions for coefficients of thermal and moisture coefficients according to mechanics of materials approach.	2	1	2	3
5.	Define interlaminar stresses and mention their impact on failure mechanism.	2	1	3	3
6.	Classify the materials based on elastic constants required to characterize them.	2	1	3	3
7.	Define minimum fiber volume fraction and critical fiber volume fraction with regard to tensile strength of UD lamina.	2	1	4	3
8.	Define Maximum stress criterion of failure of UD lamina.	2	1	4	3
9.	Differentiate between a plate and a shell element.	2	2	5	3
10.	Draw the plate element and write the equilibrium equations for the same.	2	2	5	3
	Part-B (5 × 8 = 40 Marks)				
11. a)	Identify the objectives and applications of composite materials in industry.	4	2	1	3
b)	Explain the polymer matrix composites indicating it's advantages and disadvantages.	4	2	1	3
12. a)	List the assumptions made in the micro-mechanics analysis and derive the expression for the coefficient of thermal expansion in longitudinal direction of a UD lamina.	4	3	2	4
b)	Derive an expression for longitudinal modulus (E_1) of a composite lamina.	4	3	2	4
13. a)	The engineering constants in the material coordinates for carbon/epoxy lamina are given below. E_1=140 GPa, E_2=10GPa, v_{12}=0.28 and G_{12}=6GPa. Solve for the engineering constants at a ply angle of 30^0.	6	3	3	4
b)	Illustrate Quasi-isotropic laminate. Give an example.	2	2	3	3

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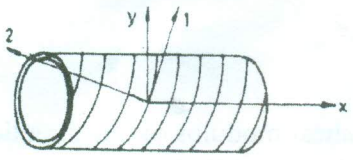
14. a)	A UD lamina with 30^0 fiber orientation is subjected to 2D state of stress as $\sigma_x = 1200\ Mpa, \sigma_y = 350\ Mpa$, and $\tau_{xy} = 800\ Mpa$. Write the condition for the lamina to be safe based on the values computed according to Tsai-Hill failure criterion.	6	4	4	4
b)	Write about de-bonding in FRP composites.	2	2	4	3
15.	A cylindrical pressure vessel is subjected to an internal pressure p. The mean diameter of the cylinder is d = 1.5 m and wall thickness = 25 mm. The vessel is filament wound, the filament winding angle is 49.46^0 with the longitudinal axis of the pressure vessel. The glass/epoxy material has the following properties. $E_1 = 38\ GPa \quad E_2 = 8\ GPa \quad G_{12} = 4\ GPa\ and\ v_{12} = 0.2$  Where E_1, E_2 are the young's modulus in the longitudinal and transverse directions, G_{12} is shear modulus and v_{12} is the major poison's ratio. For this material, permissible stresses are as follows. $\sigma_{1T} = 1100\ MPa\ \ \sigma_{1C} = 600\ MPa\ \ \sigma_{2T} = 30\ MPa\ \ \sigma_{2C} = 145\ MPa$ $\tau_{12} = 85\ MPa$ Where σ_{1T}, σ_{1C} are the ultimate tensile strength in tension and compression in the longitudinal direction, σ_{2T}, σ_{2C} are the ultimate tensile strength in tension and compression in the transverse direction and τ_{12} is the ultimate strength in shear. Determine the internal pressure that would cause the failure of the vessel according to the (a) maximum stress theory and (b) Tsai-Hill failure theory.	8	4	5	4
16. a)	Outline the functions of reinforcements in composite materials.	4	2	1	3
b)	Examine the load transfer mechanism from matrix to fiber in composite materials.	4	2	2	3
17.	Answer any ***two*** of the following:				
a)	Discuss about any four laminates with respect to the stacking sequence and orientation of lamina with in the laminate.	4	2	3	3
b)	Explain critical fiber length with regard to fiber pullout in FRP composites.	4	3	4	3
c)	Interpret the differences between membrane and flexural loads as applied to plates.	4	2	5	3

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	40%

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