

II SEMESTER M.TECH (COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: COMPOSITE MATERIALS AND MECHANICS [MME 504]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL the questions.
- ✤ Missing data may be suitable assumed.
- **1A.** Using the simple square arrangement in the figure, show that fibers with square cross sections can be packed to higher fiber volume fractions than fibers with round cross sections.



1B. Compute the stiffness matrix at 30[°] for a lamina whose stiffness matrix is given by:

$$\begin{bmatrix} Q \end{bmatrix} = 10^{3} \begin{bmatrix} 40 & 2 & 0 \\ 2 & 8 & 0 \\ 0 & 0 & 4 \end{bmatrix} MPa$$
(4)

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(6)

2A. Estimate E_1 , E_2 , G_{12} , v_{12} of glass-epoxy and graphite-epoxy composites with V_f =0.40. Constituent properties are:

Material	E (GPa)	V
Ероху	3.5	0.35
Glass fibres	70	0.2
Graphite fibres	250	0.2

- **2B.** Write short notes on load carrying phases in a composite.
- **3A.** Calculate the ratio of fiber stress to matrix stress and fiber stress to composite stress for unidirectional composites with $V_f = 35\%$. Assume that the composites are loaded in the fiber direction. $E_f = 400$ GPa, $E_m = 3.2$ GPa. (6)
- **3B.** Briefly discuss the hand lay-up method of preparing a composite laminate. (4)
- 4A. A bidirectional continuous T-300 carbon fibre-reinforced epoxy laminate is subjected to tensile load P in X direction and compressive load of 0.5P in Y direction. The laminate dimensions are 50mm X 50mm X 2mm. The following strength properties are known:

 S_{Lt} =1500MPa; S_{Lc} =1150MPa; S_{Tt} =60MPa; S_{Tc} =240MPa & S_{LTs} =75MPa, Determine the safe load P if the fibres are oriented at an angle of 60[°] using:

- Maximum stress theory.
- Azzi-Tsai Hill theory
- **4B.** Briefly discuss the types of weaves for various types of synthetic fibers. (4)
- **5A.** Determine [A], [B] and [D] matrices for $[45^{\circ}/-45^{\circ}]$ laminate. The thickness of top layer is 3mm and that of bottom layer is 2mm. Use the following material properties: E_1 =138 GPa, E_2 =10 GPa, v_{12} =0.21 & G_{12} =6.5 GPa. (6)
- **5B.** Explain briefly how the following properties are determined for a unidirectional laminates:
 - Flexural properties
 - Impact properties
- **6A.** A laminate designated by $[60^{\circ}/45^{\circ}]_{s}$ is subjected to unit load of N_x = 50MPa mm and N_y = 25 MPa mm. The thickness of every lamina is 1.5mm. Plot the variation of the stresses of the laminate. The material properties for the lamina are as follows:

$$E_1 = 181.3 \text{ GPa}, E_2 = 10.27 \text{ GPa}, G_{12} = 7.17 \text{ GPa}, v_{12} = 0.28$$
 (10)

(8)

(2)

(6)

(4)