Code No: 117MB **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, March - 2017
MECHANICS OF COMPOSITE MATERIALS
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

Part- A (25 Marks)

1.a) Differentiate orthotropic materials from isotropic materials. [2]
b) What are the main constituents of a composite material? [3]
c) Explain difference between fibers and whiskers. [2]
d) Why are reinforcement made in thin fibre form? [3]
e) Are ν_{12} and ν_{21} independent of each other for a unidirectional orthotropic lamina? [2]
f) What are the values of stiffness matrix elements C_{11} and C_{12} in terms of the Young's modulus and Poisson's ratio for an isotropic material? [3]
g) Distinguish between micro and macro mechanics approaches. [2]
h) What are the assumptions used in classical lamination theory? [3]
i) Name the yield criteria used for the failure analysis of composite materials. [2]
j) Explain what are cross-ply, symmetric and angle-ply laminate. [3]

Part-B (50 Marks)

2.a) Explain various applications of composites in detail.
b) How are composites classified? Briefly explain each type of composites with their merits and demerits. [5+5]

OR

3.a) Write the applications of composite materials for military aircrafts.
b) Enumerate six primary material selection parameters that are used in evaluating the use of a particular material. [5+5]

4.a) Explain the function of a matrix and reinforcement in a composite material.
b) What are metal matrix composites? Explain with suitable examples. [5+5]

OR

5.a) Find three applications of ceramic matrix composites.
b) Find three applications of carbon matrix composites. [5+5]

6.a) Write the number of independent elastic constants for three-dimensional anisotropic, monoclinic, orthotropic, transversely isotropic, and isotropic materials.
b) Reduce the monoclinic stress–strain relationships to those of an orthotropic material. [5+5]

OR

7. The engineering constants for an orthotropic material are found to be

$$E_1 = 4\,Msi,\ E_2 = 3\,Msi,\ E_3 = 3.1\,Msi,$$

$$\nu_{12} = 0.2,\ \nu_{23} = 0.4,\ \nu_{31} = 0.6,$$

$$G_{12} = 6\,Msi,\ G_{23} = 7\,Msi,\ G_{31} = 2\,Msi$$

Find the stiffness matrix [C] and the compliance matrix [S] for the preceding orthotropic material. [10]

8. Find the stiffness matrices [A] and [B] for a three ply [0/30/-45] graphite epoxy laminate. Assume each lamina has a thickness of 5 mm. The properties of graphite/Epoxy are E_1 = 181 GPa, E_2 = 10.3 GPa, ν_{12} = 0.28 and G_{12} = 7.17 GPa. [10]

OR

9. A beam is made of two bonded isotropic strips as shown in the figure 1. The two strips are of equal thickness. Find the stiffness matrices [A], [B], and [D]. [10]

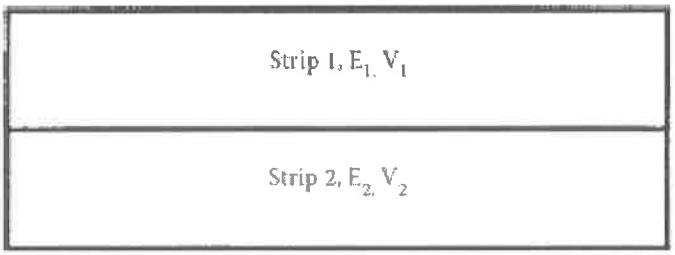

Figure 1

10.a) Explain the Tsai-Hill failure criteria for composites.

b) Explain the Tsai-Wu failure criteria for composites. [5+5]

OR

11. Determine the maximum value of $\alpha > 0$, if stresses of $\sigma_x = 3\ \alpha$, $\sigma_y = -2\ \alpha$, $\tau_{xy} = 5\ \alpha$ are applied to a 60^0 lamina of graphite/epoxy. The material properties of this lamina are given as follows:
V_f = 0.7, E_1 = 181 GPa, E_2 = 10.30 GPa, ν_{12} = 0.28, G_{12} = 7.17 GPa, X = 1500 MPa, X' = 1500 MPa, Y = 40 MPa, Y' = 246 MPa and S = 68 MPa.
Use the following failure theories
a) Maximum Stress Theory
b) Maximum Strain Theory
c) Hoffman Failure Theory. [3+3+4]

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