Registration No :

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M.Tech.
P2MDCC01

2nd Semester Regular / Back Examination 2017-18
MECHANICS OF COMPOSITE MATERIALS
BRANCH : MACHINE DESIGN, MECH. SYSTEM DESIGN, SYSTEM DESIGN
Time : 3 Hours
Max Marks : 100
Q.CODE : C638
Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1 **Answer the following questions:** *Short answer type :* (2 x 10)
a) State the functions of matrix and reinforcement in composite material.
b) Explain the difference between isotropic and anisotropic materials.
c) Write the number of independent elastic constants for three-dimensional anisotropic, monoclinic, orthotropic, transversely isotropic, and isotropic materials.
d) What is a hybrid composite? Give one example.
e) Calculate Fiber volume fraction v_f and density of composite ρ_c for a composite laminate containing 30 wt% of E-glass fibers in a polyester resin. Assume density of fiber ρ_f=2.54 g/cm3 and density of Matrix ρ_m=1.1 g/cm3.
f) What is hybrid laminate? What are the types of hybrid laminate?
g) Name one thermoplastic and one thermosetting resin used as matrix material for polymer composites.
h) Define Hooke's law.
i) What are the types of laminates given below?
[±45 I ±45],[0 I 90 I 0 I 90]
j) Distinguish between symmetric cross ply laminate and symmetric angle ply laminate.

Q2 a) What is a composite? How are composites classified? Briefly explain each type of composites with their merits and demerits. **(10)**
b) A graphite/epoxy cuboid specimen with voids has dimensions of a × b × c and its mass is Mc. After it is put it into a mixture of sulphuric acid and hydrogen peroxide, the remaining graphite fibers have a mass M_f. From independent tests, the densities of graphite and epoxy are ρ_f and ρ_m, respectively. Find the volume fraction of the voids in terms of a, b, c, M_f, Mc, ρ_f, and ρ_m. **(10)**

Q3 a) Write a detailed account about the various types of fibers, which are generally used in composite materials. **(10)**
b) Derive the expression for stiffness matrix and compliance matrix for an angle ply lamina using generalized Hooke's law. **(10)**

Q4 a) What is rule of mixtures? Derive the rule of mixtures for calculating the Young's modulus of a fiber composite loaded parallel to the fibers? **(10)**
b) If the longitudinal modulus of a glass reinforced plastic lamina is to be doubled by substituting some of the glass fibers with carbon fibers and the total fiber volume remains unchanged at 0.5.Calculate the fraction of carbon fibers. Given Ec=300GPa,Eg=70GPa,Em=5GPa. **(10)**

Q5 **a)** Write the short notes for the following: **(10)**
Symmetric laminate,
Antisymmetric laminate,
Symmetric cross-ply laminate and
Symmetric angle-ply laminate

b) Explain orthotropic, isotropic and transversely isotropic material with compliance and stiffness matrices. **(10)**

Q6 **a)** Determine the stiffness matrices for a quasi-isotropic [-60 I 0 I + 60] laminate with the following material properties. **(10)**
E_1=140GPa, E_2=10GPa, E_6=6GPa,
The thickness of the lamina is 0.2mm.

b) Answer any two of the following questions: **(10)**
   a. Discuss the variation of lamina properties with orientations.
   b. Other than the fiber and the matrix, what other factors influence the mechanical performance of a composite.
   c. Explain monoclinic material with compliance and stiffness matrices.

Q7 **a)** A bidirectional woven composite ply may yield equal longitudinal and transverse Young's modulus but is still orthotropic. Determine the angles of the ply for which the shear modulus (G_{xy}) are maximum and minimum. Also find these maximum and minimum values. **(10)**
Given : E_1 = 69 GPa, E_2 = 69 GPa, v_{12} = 0.3, G_{12} = 20 GPa.

b) The stresses in the global axes of a 30° ply are given as σx = 4 MPa, σy = 2 MPa, and τxy = –3 MPa. Find the stresses in the local axes. Are the stresses in the local axes independent of elastic moduli? Why or why not? **(10)**