Reg. No. : | | | | | | | | | | |

Question Paper Code: 92016

M.E. DEGREE EXAMINATION, DECEMBER 2013.

Elective

CAD / CAM

01PCD525 – COMPOSITE MATERIALS AND MECHANICS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. What is the significance of matrix in composite materials?
2. List few structural applications of short fiber composites.
3. Write the stiffness matrix for monolithic and orthotropic materials.
4. Define residual stress.
5. What is compliance matrix and classify it?
6. Broadly classify the types of laminate configuration.
7. Mention the commonly used failure criterion for FRP.
8. What is netting analysis?
9. List few applications of ceramic matrix composites and give their constituent elements.
10. What are the factors to be considered for material selection in composite design?

PART – B (5 x 14 = 70 Marks)

11. (a) Classify the composite materials based on
(i) Matrix materials. (7)
(ii) Reinforcement materials and explain them briefly. (7)

Or

(b) (i) Explain in detail the various fiber surface preparation techniques. (7)

(ii) Discuss the mechanical, thermal and physical properties of UD fiber composite laminates. (7)

12. (a) (i) Calculate the longitudinal modulus and tensile strength of a UD composite containing 60% by volume of carbon fibers (E_f = 294 GPa and σ_f = 5.6 GPa) in an epoxy matrix (E_m = 3.6 GPa and σ_m= 105 MPa). What fraction of the load is carried by fibers in the composite? (8)

(ii) An isotropic lamina has E = 100KN/mm^2 and ν = 0.25. Determine the reduced stiffness matrix. (6)

Or

(b) Derive the expression to get transformation matrix of rotation for stress and strain relation. (14)

13. (a) (i) What are the assumptions to be made during analysis of laminated composite? (6)

(ii) Write short notes on inter laminar stresses. (8)

Or

(b) (i) Compute [A] matrix for a [0/±45] laminate with the following laminate properties E_1 = 145 GPa, E_2 = 10.5 GPa, E_6 = 7.5 GPa, and ν_{12} = 0.28. Thickness of each lamina is 0.25 mm. (8)

(ii) Discuss about dynamic analysis of composite plates. (6)

14. (a) An angle-ply lamina has the following properties in the fibre direction: F_1 = 1280 MPa, F_2 = 49 MPa, F_6 = 69MPa, E_1 = 35GPa, E_2 = 7 GPa, E_6 = 3 GPa and ν_{12} = 0.3. A tensile load of σ_x = 2 MPa is applied at an angle 60^o to the fibre direction. Check the safety of the laminate as per failure theories. (14)

Or

(b) Using the Tsai-Hill failure criterion for a UD lamina subjected to pure shear; find an expression for the shear stress at failure in terms of F_1, F_2 and F_6. The loading axis is inclined at θ to the principal material axis. (14)

15. (a) (i) Discuss the different stages of failure modes of composite bolted joints with neat sketches. (9)

(ii) Calculate the net tensile stress at the bolt hole edge for the composite bolted joint of the 1.5 mm thick laminate. Permissible tensile strength of the laminate is 5.6 N/mm2. The width of the plate is 25 mm with a 6 mm bolt diameter and is subjected to 45 N/mm. And also calculate the margin of safety. (5)

Or

(b) (i) Explain in detail about the metal matrix and ceramic matrix composites. (9)

(ii) Enumerate the various environmental issues related to composite materials. (5)

PART – C (1 x 10 = 10 MARKS)

16. (a) Determine the inplane shear modulus G_{12} of a glass/epoxy composite with properties G_{12f} = 28 GPa, G_m = 1300 MPa, V_f = 0.6 using the strength of materials approach and the Halpin-Tsai relationship with $\xi_2 = 1$. (10)

Or

(b) Discuss in detail the applications of composite materials in medical applications. (10)