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B.Tech IV Year II Semester (R13) Regular Examinations April 2017

COMPOSITE MATERIALS

(Mechanical Engineering)

Time: 3 hours

1

Max. Marks: 70

PART – A

(Compulsory Question)

- Answer the following: $(10 \times 02 = 20 \text{ Marks})$
- Differentiate between an alloy and a composite. (a)
- What are the advantages of composites over conventional materials? (b)
- What is the difference between isotropic and anisotropic materials? (c)
- (d) State the generalized Hooke's law.
- What is the difference between minimum volume fraction and critical volume fraction in FRP composites? (e)
- Clearly explain angle ply laminates. (f)
- What is meant by off axis and on axis stiffness? (g)
- Explain extension bending coupling in a FRP laminate. (h)
- What is first ply failure? (i)
- State the factors that inference the properties of FRP compositor. (j)

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 Classify the different types of composite materials and discuss their applications.

OR

3 Explain various reinforcement fibres used in polymer matrix composites and their relative advantages.

UNIT – II

With a neat sketch, explain how FRP composites are produced in RTM. 4

OR

- A unidirectional composite is subjected to the following stresses: 5 (a) Longitudinal stress σ_L = 3.0 MPa, Transverse Stress σ_T = 6.5 MPa, Shear stress (in plane) τ_{LT} = 3.5 MPa. Find normal and shear strains if $E_L = 140$ GPa; $E_T = 3.5$ GPa and $G_{LT} = 4.2$ GPa. $Y_{LT} = 0.4$ & $\Upsilon_{TL} = 0.1$ (Y is poissions ratio).
 - How the stiffness matrix is transformed from on-axis to off-axis? (b)

UNIT – III

Deduce an expression for evaluating transverse stiffness using constant stress approach. Make your 6 comments on the predicted values.

OR

7 Calculate the ratios of transverse modulus of composite to the matrix modulus for the glass epoxy and carbon epoxy composites with 10% and 50% by volume fraction. Take $E_G = 70$ GPa, $E_C = 350$ GPa; $E_{epoxy} = 3.5$ GPa using Halpin-Tsai equations.

UNIT – IV

Deduce A, B, D matrices for a laminate from the first principles. 8

OR

A three ply laminate has top and bottom layers of each 3 mm thick and oriented at 45⁰ to the laminate 9 reference axis. The thickness of the middle layer is 6 mm and oriented at 0°. Obtain A, B, D matrices if 20 0.7 0

each lamina has same properties and on-axis stiffness matrix is: Q 0.7 20 GPa 0

UNIT – V

- Briefly discuss symmetric laminates, angle ply laminates and express their force and moment resultants 10 relations with mid plane strains and curvatures. OR
- 11 A $[0/\pm 60]$ graphite epoxy laminate is quasi isotropic. Find and prove:

(i)
$$A_{11} = A_{22}$$
; $A_{16} = A_{26} = 0$ and $A_{66} = \frac{A_{11} - A_{12}}{2}$.
(ii) B matrix $\neq 0$.
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