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Question Paper Code : X86910

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2021
Second Semester
Structural Engineering
ST5006 – MECHANICS OF COMPOSITE MATERIALS
(Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

(10×2=20 Marks)

1. Define composite.
2. List out the characteristics of unidirectional long fiber composites.
3. Differentiate between orthotropic and anisotropic materials.
4. What is meant by residual stresses ?
5. Write down the equilibrium equations for bending of laminated plates.
6. State the various forces that acting in the laminated composites.
7. Why maximum stress and strain important in failure mechanisms in composites ?
8. Discriminate the various methods of failure analysis ?
9. Discuss about factors to be considered in the design of composites.
10. Write a short note on the matrix composites.

PART – B

(5×13=65 Marks)

11. a) Find a description of how carbon and graphite fibers are made and summarize it.
(OR)
b) Describe and discuss thermoset-matrix and thermoplastic-matrix materials. Contrast their production times if you were to build a composite structure with both materials.



12. a) A uniaxial load is applied to a 10° ply. The linear stress-strain curve along the line of load is related as $\sigma_x = 123 \epsilon_x$, where the stress is measured in GPa and strain in m/m. Given $E_1 = 180$ GPa, $E_2 = 10$ GPa and $\gamma_{12} = 0.25$, find the value of (1) shear modulus, G_{12} and Young's modulus E_x for a 60° ply.

(OR)

- b) Derive the governing differential equations for a symmetric cross ply laminated plate.
13. a) Derive the equilibrium equations for a laminated composite plate subjected to transverse loads.
- (OR)
- b) A hybrid lamina uses glass and graphite fibers in a matrix of epoxy for its Construction. The fiber volume fractions of glass and graphite are 40 and 20% respectively. The specific gravity of glass, graphite and epoxy is 2.6, 1.8 and 1.2, respectively. Find (i) Mass fractions and (ii) Density of the composite.
14. a) Discuss the failure mechanisms in fibre reinforced polymer matrix composites and describe a failure theory which is widely used for testing of polymer composites.

(OR)

- b) Explain in detail about Fracture mechanism in composites with sandwich construction.
15. a) Explain with examples of applications of composite materials.

(OR)

- b) Review composite materials which impact the environmental issues.

PART – C

(1×15=15 Marks)

16. a) Compute in-plane stiffness matrix $[A]$ for a $[0 \pm 45]$ laminate with the following laminate properties. $E_1 = 145$ GPa; $E_2 = 10.5$ GPa; $E_6 = 7.5$ GPa; $\gamma_{12} = 0.28$. Thickness of each lamina is 0.25 mm.

(OR)

- b) An angle – ply lamina made of S-glass/epoxy has the following properties in the principal fibre direction $F_{1T} = 1280$ MPa; $F_{1C} = 622$ MPa; $F_{2T} = 49$ MPa; $F_{2C} = 245$ MPa; $F_6 = 69$ MPa; $E_1 = 35$ GPa; $E_2 = 7$ GPa; $E_6 = 3$ GPa; $\gamma_{12} = 0.3$, A tensile load of 2 MPa is applied at an angle of 60° to the principal fibre direction. Check the safety of the laminate with any three failure theories.
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