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Question Paper Code : 13695

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Fifth Semester

Mechanical Engineering

080120028 — COMPOSITE MATERIALS

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate between continuous and particulate reinforcement.

2. State any two important advantages of composites in compare with metals.

3. Graphically represent the following laminates

   (a) $\left(45^\circ / \overline{90^\circ}\right)_s$

   (b) $\left(0/\left(\pm 45^\circ / 60^\circ / 90^\circ\right)_2\right)_s$

4. Differentiate between thermo set and thermoplastics.

5. Name any two components which are being made using filament winding method.

6. What is the advantage of pre-pregs in compare with fiber reinforced laminas which are made using fiber mats?

7. How to calculate the properties of a mixture of two different materials using rule of mixtures?

8. State Tsai-Wu Failure criterion applicable for FRP laminates.

9. Why the residual stresses are developed during fabrication?

10. State important applications of ceramic matrix composites.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Differentiate between isotropic, anisotropic and orthotropic materials each with the example. (5)

(ii) Write in detail about various applications of composite materials. (6)

(iii) Why the composite materials are preferred in many applications in compare with the conventional isotropic materials? (5)

Or

(b) (i) Derive the expressions from the constitutive relations for stiffness matrix of a lamina containing the fibers along x-direction. (8)

(ii) Derive the expressions for stiffness matrix of a lamina containing the fiber along 'θ' direction measured in anticlock wise w.r.to x-axis. (8)

12. (a) Explain in detail of different types of fibres with their applications and properties (Discuss 5-different fibres). (16)

Or

(b) Explain in detail of different types of matrix materials with their applications and properties (Discuss about polymer matrix materials, Metal matrix materials and ceramic matrix materials). (16)

13. (a) Explain briefly the hand layup method and also using the compression molding machine for making laminates. Take an example of a laminate of $(0/(\pm 45^\circ/60^\circ/90^\circ)_2)_s$ using epoxy as matrix with glass fiber for explaining the same. (16)

Or

(b) Explain the following methods of making composites in detail with line diagram.

(i) Autoclave method (6)

(ii) Filament winding method. (10)

14. (a) Consider a 4-ply laminate $[\pm 45^\circ]_s$, with a thickness of 4mm for each layer. Its properties referred to the principal material directions is given as

$$[Q]=\begin{bmatrix} 25 & 0.8 & 0 \\ 0.8 & 3.0 & 0 \\ 0 & 0 & 0.8 \end{bmatrix} \text{ GPa.}$$

Obtain 'A' and 'D' matrices and explain various characteristic of this laminate with reference to these matrices. (16)

Or

(b) A carbon/epoxy cross-ply laminate $(0/90)_s$ consists of unidirectional plies and is subjected to a tensile force $N_x = 300N/mm$. The ply is 0.2 mm thick and elastic properties in kN/mm^2 are

$E_1 = 150$, $E_2 = 15$, E_6=6, $\upsilon_{12} = 0.3$

The ply strengths for the material in N/mm^2 are

$F_{1T} = 1600$, $F_{1C} = 1300$, $F_{2T} = 60$, $F_{2C} = 260$, $F_6 = 80$

Check whether failure will occur according to maximum stress theory. (16)

15. (a) Discuss in detail about the following failure theories used for analysis of fiber reinforced laminates.

(i) Maximum stress theory (5)

(ii) Maximum strain theory (5)

(iii) Tsai-Hill theory. (6)

Or

(b) A rectangular panel with dimensions as shown in Fig.Q 15 (b) is to be designed. Displacement limits are 0.5% of edge dimensions and 1° shear angle. The fiber volume fraction is 0.6. Assume a factor of safety 2.0 on the specified load. Tensile strength of the ply = 1.52 GPa. Ply thickness is 0.127 mm. The laminate is to be sized such that ply strengths are not exceeded and it should not buckle at the design load. (16)

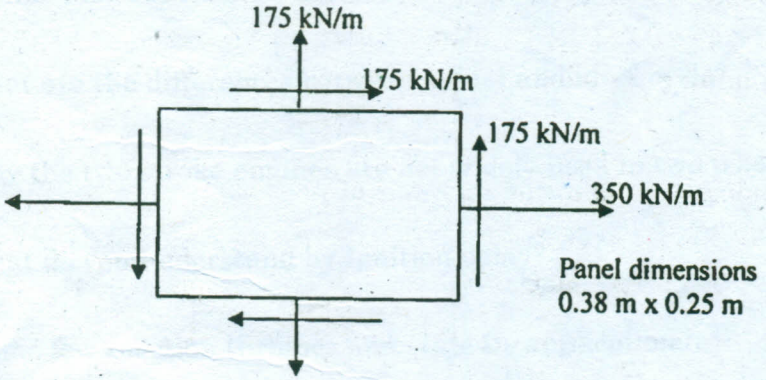

Fig. Q.15 (b)