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Question Paper Code : 31017

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010.

Seventh Semester

Aeronautical Engineering

AE 1402 — COMPOSITE MATERIALS AND STRUCTURES

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate orthotropic materials from isotropic materials.

2. Name any two important applications where fiber reinforced laminates were used.

3. How does one evaluate the material properties along arbitrary directions in a fiber reinforced lamina knowing the properties along principal material directions?

4. Name any two matrix materials with fibers used in fiber reinforced laminates.

5. Differentiate lamina from laminate.

6. For a composite laminate what does the matrix $[A]$ represent?

7. What is meant by sandwich plate/panel?

8. Name the materials used for constructing sandwich plates.

9. Name any two components that were made by filament winding.

10. Classify thermosetting polymers.

PART B — (5 × 16 = 80 marks)

11. (a) Starting from generalised Hooke's law, derive the material stiffness matrix Q for a fiber reinforced lamina in terms of elastic constants in principal material directions. (16)

Or

(b) Explain various applications of composites in detail. (16)

12. (a) Consider a two-ply laminate with the ply orientations of 0° and 45° with laminate axis as shown in Fig. 12 (a). The bottom lamina is a 0° layer with thickness of 5 mm, whereas the 45° top lamina is 3 mm thick. The stiffness matrices Q, referred to the principal material directions are the same for the two layers :

$$[Q]=\begin{bmatrix} 20 & 0.7 & 0 \\ 0.7 & 2.0 & 0 \\ 0 & 0 & 0.7 \end{bmatrix} \text{ GPa}$$

Obtain laminate stiffness matrix. (16)

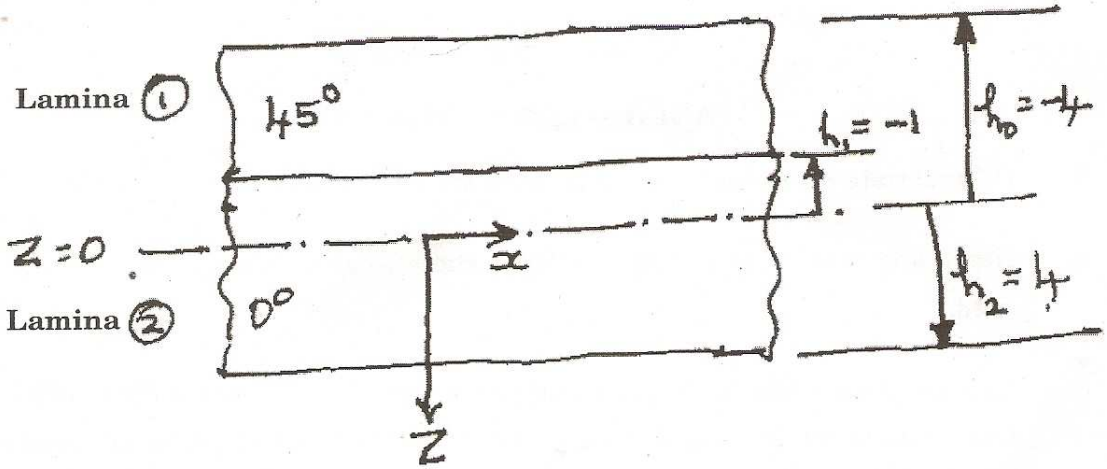

Fig. 12 (a)

Or

(b) Starting from fundamentals, derive the contents of A, B and D matrices. (16)

13. (a) Explain various features for the following laminates.

(i) Cross-ply laminates (3)

(ii) Angle-ply laminates (7)

(iii) Symmetric laminates. (6)

Or

(b) Derive the fourth order governing differential equation for bending of composite plate due to load applied in Z – direction. (16)

14. (a) The unidirectional lamina has the following properties in the principal fiber 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, $E_6 = 3\,GPa$ $\gamma_{12} = 0.3$. (16)

The loading is

$\sigma_x = -2$ MPa, $\sigma_y = 4\,MPa$, $\sigma_{shear} = -1\,MPa$ fiber orientation 60°

Check the safety based on different failure theories.

Or

(b) Discuss the following failure theories which are applicable for fiber reinforced polymer composites.

(i) Maximum strain theory. (5)

(ii) Tsai-Hill theory (6)

(iii) Tsai-Wu theory. (5)

15. (a) Explain the following in detail :

(i) Auto clave molding (6)

(ii) Filament winding (6)

(iii) Pultrusion. (4)

Or

(b) Explain the following in detail :

(i) Resin Transfer molding (10)

(ii) Preparation of fiber reinforced laminates by hand lay-up. (6)