K 4018

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

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 between isotropic, orthotropic and anisotropic materials.

2. List the common matrix materials used for composites.

3. Differentiate between lamina and laminate.

4. Write the general compliance matrix for a fiber reinforced materials.

5. Show the diagram to represent the following laminate $(45^\circ/\overline{90})_s$.

6. Define
   (a) angle ply laminate
   (b) cross ply laminate.

7. What are the advantages of sandwich structures?

8. Name the materials used for sandwich construction.

9. Name any three manufacturing methods for mass production of fiber-reinforced composite structures.

10. What are the advantages of compression moulding method for making sheet molding compounds in comparison with other methods?

PART B — (5 × 16 = 80 marks)

11. (a) Derive the material stiffness matrix 'Q' for plane fiber reinforced lamina starting from the fundamentals. (16)

Or

(b) Write a detailed account about the various types of fibers, which are generally used in composite materials. (16)

12. (a) A two ply laminate having its top and bottom layers are 3 mm and 5 mm respectively. The stiffness matrix 'Q' referred to the principal material directions are the same for the layers and is given as $[Q]=\begin{bmatrix} 20.0 & 0.7 & 0 \\ 0.7 & 2.0 & 0 \\ 0 & 0 & 0.7 \end{bmatrix}$ GPa. Obtain A, B and D matrices of the laminate.

Or

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

Pg 152

13. (a) A four layered angle ply laminate of $[\pm 45°]_s$ with a thickness of 3 mm for each layer. The stiffness matrices Q, referred to the principal material directions are same for all the layers and is given as $[Q]=\begin{bmatrix} 20.0 & 0.7 & 0 \\ 0.7 & 2.0 & 0 \\ 0 & 0 & 0.7 \end{bmatrix}$ GPa. Numerically obtain A, B and D matrices. And discuss its important characteristics with respect to A, B and D matrices.

Or

(b) A three-ply symmetric laminate $[45/\overline{0}]$, which has top and bottom layers are each 3 mm thick and middle layer is 6 mm thick. The 'A' matrix for the laminate is given as $[A]=\begin{bmatrix} 159.3 & 35.1 & 27.0 \\ 35.1 & 51.3 & 27.0 \\ 27.0 & 27.0 & 35.1 \end{bmatrix}$ GPa-mm. Calculate the stresses and strains in the individual layer if the laminate is subjected to the forces $N_x = 1000$ N/mm, $N_y = 200$N/mm and $N_{xy} = 0$.

14. (a) Derive the governing differential equation for the bending of a composite plate applied with load along normal to surface of the plate. (16)

Or

(b) Discuss in detail the manufacturing of a sandwich beam. (16)

15. (a) Explain how polymer composites are manufactured. Give examples. (16)

Or

(b) Explain compression moulding of composites. (16)