KUMARAGURU
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B.E DEGREE EXAMINATIONS: NOV/ DEC 2014

(Regulation 2009)

Seventh Semester

AERONAUTICAL ENGINEERING

AER118: Composite Materials And Structure

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Composite materials are
    a) Metallic Compounds
    b) Non metallic Compounds
    c) Mixture of Chemical Elements
    d) Heterogeneous material with definite directional properties

2. Plywood is
    a) Homogeneous material
    b) Laminate
    c) Sandwich material
    d) Honeycomb

3. GLARE is a composite material extensively used in
    a) A 300
    b) Boeing 707
    c) Cessna 172
    d) A 380

4. The factors affecting fiber performance in the composite are
    a) Orientation
    b) Length
    c) Shape
    d) All of these

5. The macro mechanical analysis of a lamina is based on_____properties
    a) Average
    b) Maximum
    c) Minimum
    d) Central

6. Aluminum is an example for
    a) Isotropic material
    b) Anisotropic material
    c) Orthotropic material
    d) None of these

7. Sandwich panels consisting of thin facings are also called

   a) Cover   b) Lap

   c) Skin   d) All of these

8. Carbon-Carbon matrix composites retain much of their strength up to

   a) 500°C   b) 1500°C

   c) 2500°C   d) 1000°C

9. A laminate is called an angle ply laminate if it has plies of the same material and thickness and only oriented at

   a) $+\theta$ b) $-\theta$

   c) $\pm\theta$ d) None of these

10. Strength Ratio (SR)>1 implies the

    a) Lamina is unsafe   b) Lamina is safe

    c) Failure load   d) None of these

PART B (10 x 2 = 20 Marks)

11. Define micro mechanics and macro mechanics in the analysis of composites.

12. Define fiber composites and given atleast three examples. Where they are used in aircraft?

13. Explain anisotropic materials and give two examples of each.

14. State generalized Hookes's law for 2-D cross ply lamina.

15. Define the terms "Neutral Axis" and "Arbitrary axis" with a neat sketch.

16. List the various failure modes in composite structures.

17. What type of sandwich materials are used for the manufacture of radomes.

18. State the flexural rigidity equation for a sandwich beam with different facing thicknesses.

19. Mention some application of metal matrix composites.

20. Differentiate between helical winding and hoop winding.

PART C (5 x 14 = 70 Marks)

21. a)   Describe the process of manufacturing carbon & graphite fibers.

(OR)

b)   With a neat sketch, indentify the applications of composite materials in the construction of a large passenger aircraft and mark the type of composite materials used in various assembles.

22. a)   Derive the stress-strain relationship for a laminar of arbitrary orientation.

(OR)

b) (i)   Explain Tsai-Hill failure theory.

     (ii)   What do you understand by characterization of lamina?

     (iii)   Explain the methods of characterization of lamina experimentally.

23. a) (i)   Derive the expression for bending rigidity of composite panel.

     (ii)   Calculate the flexural rigidity of a honeycomb sandwich panel with stainless steel facing and aluminum foil core with
$h = 20$ mm
$b = 20$ mm
$t_1 = 2$ mm
$t_2 = 1$ mm
$E_{steel} = 210$ GPa
$E_{al} = 70$ GPa
$v = 0.3$

(OR)

b)   A laminate cross section is 300mm wide, 10mm thick and made up of three layers. All layers are made from unidirectional fibers and all fibers are aligned in the loading direction. The top layer is Glass/Epoxy with $V_f = 0.6$ and 3mm thick, the middle layer is Carbon/Epoxy with $V_f = 0.33$ and 4mm thick, the bottom layer is Kevlar/Epoxy with $V_f = 0.4$ and 3mm thick. Using micromechanics, calculate the load carrying capacity of the laminate. Given: The tensile strength $\sigma_{epoxy} = 0.07$GPa, $\sigma_{glass} = 2.1$GPa, $\sigma_{carbon} = 2.8$GPa, $\sigma_{kevlar} = 3.0$GPa. The tensile modulus $E_{epoxy} = 6$GPa, $E_{glass} = 73$GPa, $E_{carbon} = 240$GPa, $E_{kevlar} = 130$GPa.

24. a)   Identify the three important factors that affect the quality while preparation of the composites.

(OR)

b)   State the two forms of sandwich structures made from laminar composite materials. Explain each form in brief.

25.   a)   (i)   Explain Netting Analysis.

         (ii)   State the assumptions made in Netting Analysis.

         (iii)   Derive the expression for winding angle for a composite cylinder with flat ends and subjected to internal pressure.

         (iv)   Define critical winding angle.

(OR)

b)   (i)   Enumerate the properties and functions of resins.

         (ii)   Explain the two types of molding processes highlighting the differences and uses.

         (iii)   Explain the manufacturing process of carbon fiber.

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