



Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



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(01)

V SEMESTER B.TECH (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: AIRCRAFT MATERIALS AND COMPOSITES [AAE 311]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ANY FIVE FULL the questions.
- ✤ Missing data may be suitable assumed.
- 1A. Define the following with reference to composites. (i) Gelation (ii) post curing (iii) (04) woven rovings (iv) sandwich composites
- **1B.** Derive the equation for the shear composite modulus of a laminate. (04)
- 1C. Differentiate between major and minor Poisson's ratio and write the mathematical (02) relation between the two.
- 2A. Distinguish between the fatigue limit and fatigue strength of materials.
- **2B.** Longitudinal axis of a lamina makes 45° with the X-axis. It is subjected to the following stresses. σ_x = 20MPa, σ_y =0 and τ_{xy} =20MPa. Calculate the stresses along the longitudinal and transverse direction.

$$[T_1] = \begin{bmatrix} \cos^2 \theta & \sin^2 \theta & 2\sin \theta \cos \theta \\ \sin^2 \theta & \cos^2 \theta & -2\sin \theta \cos \theta \\ -\sin \theta \cos \theta & \sin \theta \cos \theta & \cos^2 \theta - \sin^2 \theta \end{bmatrix}$$
(06)

What would be the change in the stresses in transverse and longitudinal direction if the angle is changed to 60^{0} ?

- **2C.** Draw a neat sketch of the lamina indicating x, y, L and T axes.
- **3A.** Explain the gas pressure infilteration technique for production of metal matrix (04) composites
- **3B.** Briefly explain the Maximum stress, Maximum strain and the Maximum work theory (03) of failure.
- **3C.** A graphite-epoxy lamina shows the following strength properties. σ_{LU} = 1725MPa, (03) σ'_{LU} = 1350MPa, σ_{TU} = 40MPa, σ'_{TU} = 275MPa and τ_{LTU} = 95MMPa. Using the maximum work theory of failure estimate whether the lamina fails if it subjected to the following stresses σ_x = 200MPa, σ_y =0 and τ_{xy} =200MPa and the orientation of fibers is 45⁰ with the X-axis.
- **4A.** Discuss the PAN based production method of carbon fibers.

- **4B.** Derive the expressions for stress-strain relationship for generally orthotropic material (05)
- **4C.** What is a balanced orthotropic lamina?
- 5A. Explain the pultrusion method for the production of polymer matrix composites.
- **5B.** A two ply laminate with 0^0 and 45^0 ply orientation. The bottom lamina is 0^0 with 4mm thickness and the top lamina is 45^0 with a thickness of 2mm. Evaluate A, B and D matrices for the laminate if both the laminae have identical stiffness matrix given $\begin{bmatrix} 20 & 0.7 & 0 \end{bmatrix}$

by
$$Q = \begin{bmatrix} 20 & 0.7 & 0 \\ 0.7 & 2 & 0 \\ 0 & 0 & 0.7 \end{bmatrix}$$
 GPa. And $\begin{bmatrix} Q \end{bmatrix}_{45^0} = \begin{bmatrix} 0.55 & 5.15 & 4.5 \\ 5.15 & 6.55 & 4.5 \\ 4.5 & 4.5 & 5.15 \end{bmatrix}$

- **5C.** Schematically represent the following laminate given by the code $[45/0_2/60/90]_s$ (01)
- 6A. Illustrate the sol-gel infilteration process of production of ceramic matrix composites. (04)
- **6B.** Briefly discuss about Thermography non-destructive technique (03)
- **6C.** Explain the ultrasonic technique for identifying faults in composites. (03)

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