INDIAN INSTITUTE OF TECHNOLOGY
KHARAGPUR -721302

Date: 25.02.13, 9-11 AM
Mid-Autumn Semester 2012-13
Sub. No. AE40006
4th Yr. B.Tech (H), DD

Time: 2 Hours Full Marks: 30
Dept: Aerospace Engineering
Sub. Name: Composite Structures

No. of Students: 25

Instruction: **Answer all questions. Show all steps of calculations and derivations. Make suitable assumptions wherever necessary and state them.**

Q.1 (a) What is composite material? What are the advantages and disadvantages of composite materials over metals? Classify composite materials as per their constituents fiber and matrix.

(c) Use the 'rule of mixture' to determine the following material properties of composite E_{11}, G_{12} in terms of constituents' properties. Explain the associated assumptions.

1+2+2+5

Q.2 (a) Derive mathematical expression for longitudinal thermal expansion coefficient (α_{11}) of an unidirectional composite. The thermal expansion coefficient of fibre and matrix are α_{11f} and α_{11m} respectively.

(b) State the generalized Hook's Law for a three-dimensional elastic material and show that there are thirteen independent elastic constants for a monoclinic material.

5+5

Q.3 a) Derive stress and strain transformation matrices for plane stress problem considering 2D orthotropic material.

b) Show that $\left[Q_{ij}\right]_{off} = \left[T_{\sigma}^{-}\right]\left[Q_{ij}\right]_{on}\left[T_{\varepsilon}^{+}\right]$; i,j=1,2,6

4+4+2