Introduction to Application of Polymer Composite materials in structural engineering

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1. Write a computer program to calculate the general orthotropic elastic constants $Qbar_{ij}$ in terms of the orthotropic elastic constants Q_{ij} . Plot $\bar{Q}_{ij}$ for the graphite/epoxy prepreg as a function of θ for the range $0 \leq 180° \leq \theta$

2. Based on the requirement that at least one ply each of $\theta=0°, 45°, -45°$ and $90°$ be used and that all plies are the same material and thickness, construct a minimum thickness laminate and evaluate A_{ij}, B_{ij} and D_{ij} for the following situations.
   a. Orthotropic with respect to in-plane forces. That is $A_{16}=A_{26}=0$.
   b. $B_{ij}=0$
   c. Orthotropic with respect to bending force. That is $D_{16}=D_{26}=0$.
   d. Requirements (a) and (b) simultaneously
   e. Requirements (a) and (c) simultaneously

   If it isn't possible to satisfy any of above, explain why.

3. A symmetric laminate is composed of four plies with ply angles $\pm\theta$. If the total thickness of the laminate is (t), determine the individual thicknesses that will guarantee that the laminate is orthotropic with respect to bending force. That is $D_{16}=D_{26}=0$.

Graphite/epoxy Mechanical properties:

$E_{11} = 164.0$ GPa

$E_{22} = 8.30$ GPa

$G_{12} = 2.10$ GPa

$\nu_{12} = 0.34$

Thermal properties:

$\alpha_1 = -4.5\text{e-}7$ /°C

$\alpha_2 = 3.17\text{e-}5$ /°C

Please bear in mind following points:
1) All code's source files must be provided.
2) Exercises must be sent before the due date.
3) Illustrations of problems must be provided.
4) Please send only one zipped file containing the source codes and the report.

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