Mechanics of Composite Materials **September 16, 2014**

Mechanical Engineering MECH 530 Due : **September 23, 2014**

Project, Assignment #2

Review of Assignment #1

The first part of the project was to write an input and output interface for your program. The following should have been used as sample material properties: AS/H3501. The geometry parameters, total number of layers, n, individual ply thickness, t_i, ply orientation, θ_i, core thickness, $2z_c$ were input with a specific layup used as an illustrative example. All input parameters were output in SI units as well as the "on-axis" [S] and [Q] matrices.

Assignment #2

Add the capability of dealing with "off-axis" quantities. In your code, include the following algorithms (as subroutines or whatever you are most comfortable with):

• The ability to calculate transforms of both stresses and strains

1) From off-axis to on-axis (positive sign convention)

2) From on-axis to off-axis (replace the ply angle θ by $-\theta$ in the transformation)

Note: you may use either of Table 3.1, 3.2, 3.3 for stress, and either of Table 3.4, 3.5, 3.6 for strain. (Tables 3.2 and 3.5 are usually preferred, but not required)

• The ability to calculate transforms of both modulus $[Q_{ij}]$ (i,j=1,2,6) and compliance $[S_{ij}]$ (i,j=1,2,6). Use the multiple angle formulation only, i.e., make use of Tables 3.9 and 3.12, (not 3.8 and 3.11).

• As an intermediate step, it is useful to print out the 5 modulus combinations (U's) and the 5 compliance combinations (the other U's) to check for errors.

Print out the following quantities (with appropriate units!):

Example 1: For a given layup, [45/0/-45/90]s, and Kevlar/epoxy (Kev49/epoxy) material, print out off-axis [Q] and [S] matrices for each of the first 4 layers (the symmetric other half will have the same quantities), in SI units (2x4 = 8 matrices in total).

Example 2: for a simple layup of [+30] Kevlar/epoxy (Kev49/epoxy) , (one layer only!) and an off-axis stress vector of $(\sigma_1,\sigma_2,\sigma_6)$ = (420, -165, -135) MPa, find the resulting off-axis strain using the off-axis compliance matrix $[S_{ij}]$ (i,j=1,2,6) and the on-axis stresses (using a stress transformation) and on-axis strains (using a strain transformation). (Note that there is more than one way to obtain all of the desired quantities).

Note: Appropriate items that were output in Assignment #1 should not be removed from your programs. Please keep them in, as they will enhance the clarity of your output report file.