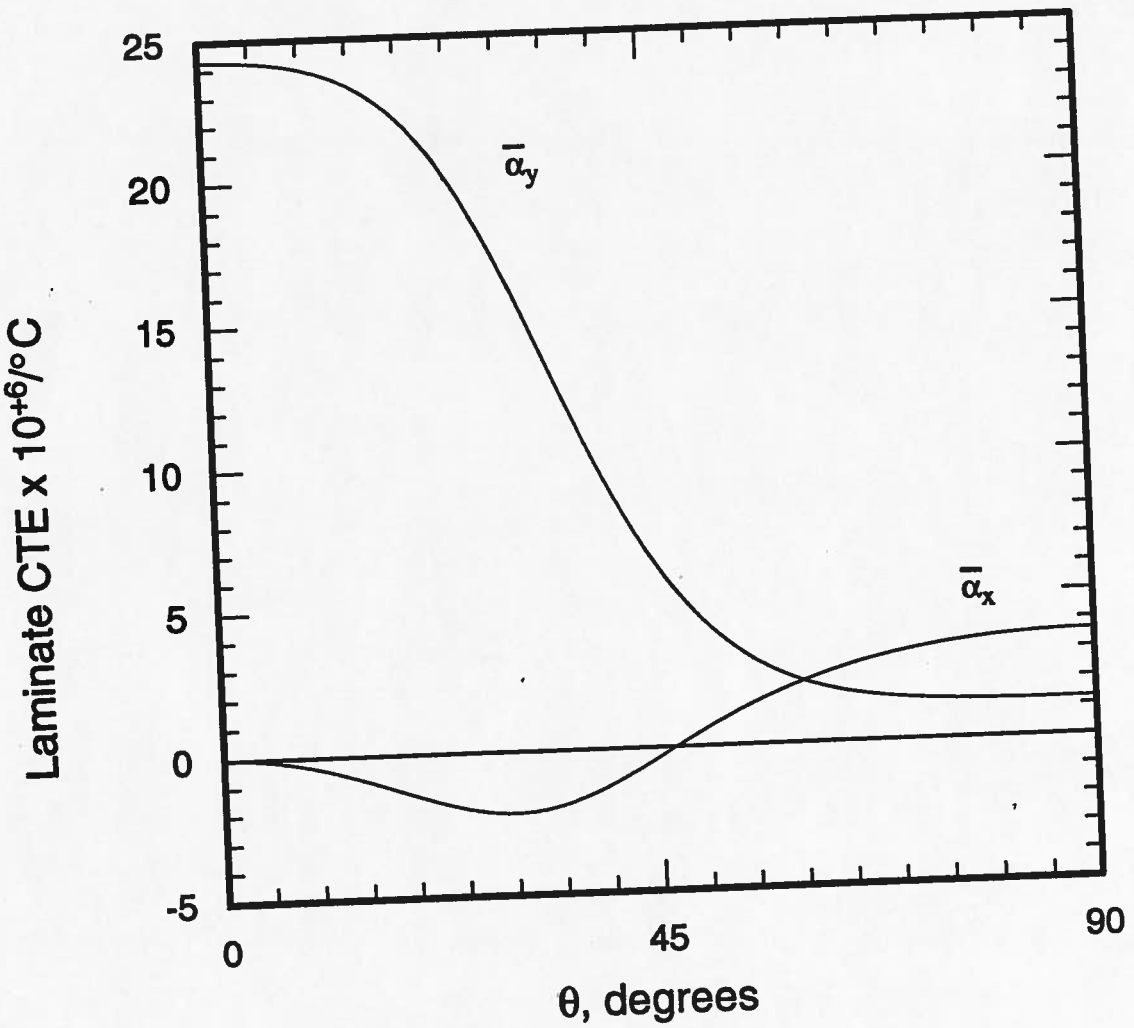
Homework #10

Exercises for Section 11.8, Exercise 1 (p. 469)

The variations of $\bar{\alpha}_x$ and $\bar{\alpha}_y$, as defined in eq. 11.93, with θ are shown in the plot on the following page. At $\theta \approx 46.7°$, $\bar{\alpha}_x = 0$. (Note that at $\theta \approx 60°$, $\bar{\alpha}_x \approx \bar{\alpha}_y$.) The table below compares the stresses due to $\Delta T = -150°C$ for the laminate with $\bar{\alpha}_x = 0$, i.e., a $[\pm 46.7/0]_S$ laminate, with the stresses in a $[\pm 30/0]_S$ laminate. As can be seen, except for the 0° layers, the stresses in the principal material coordinate systems in the two laminates are similiar. (The stresses for the $[\pm 30/0]_S$ laminate are taken from eq. 11.104)

Table 1: Comparison of stresses

	$\theta \approx 46.7°$	$\theta = 30°$
layers 1 & 6		
$\sigma_{1,\,MPa}$	-59.3	-55.2
σ_2	38.2	21.1
τ_{12}	-3.66	-10.84
layers 2 & 5		
σ_1	-59.3	-55.2
σ_2	38.2	21.1
τ_{12}	3.66	10.84
layers 3 & 4		
σ_1	8.02	53.4
σ_2	34.2	14.64
τ_{12}	0	0


25
20
15
10
5
0
-5
0
45
90
θ, degrees
Laminate CTE x 10+6/°C
$\bar{\alpha}_y$
$\bar{\alpha}_x$