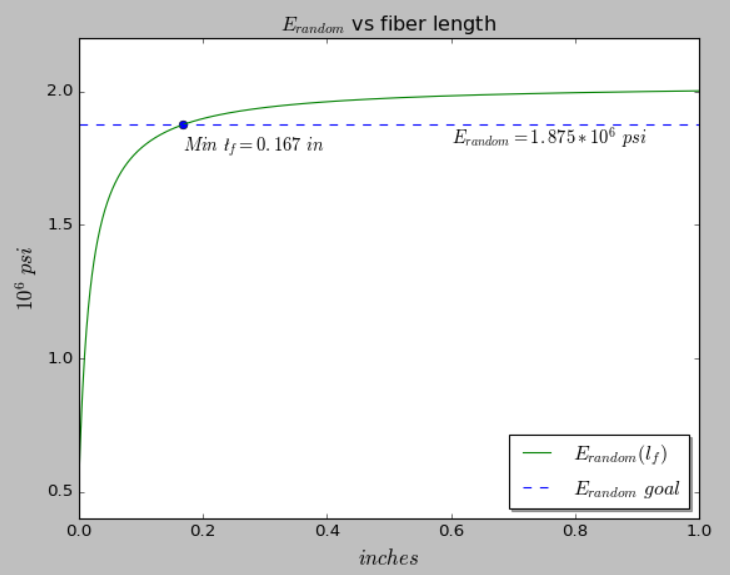
**#1**

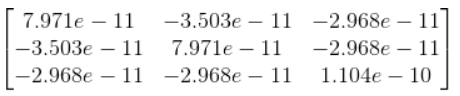
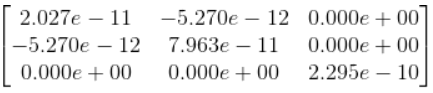
* The new tensile modulus goal is 150% of the previous composite, resulting in Erandom of 1.875 \*10^6 psi.
* First need to find the volume fractions from the mass fraction of 20%
* Use Halpin-Tsai equations modified for discontinuous fiber to find E1 and E2
* Substitute in Tsai and Pagano equation for Randomly oriented discontinuous fiber
* Now have an equation with **fiber lengt**h as single variable
* Set 3/8\*E1 + 5/8\*E2 – Erandom = 0 and solve for **fiber length**

*-1511576.3149403 + 150000.0\*(33717.0263788969\*l\_f/(3333.33333333333\*l\_f + 75.0) + 1)/(1 - 10.1151079136691/(3333.33333333333\*l\_f + 75.0)) = 0*

* The graph shows the minimum fiber length that will achieve the desired tensile modulus



**#2**



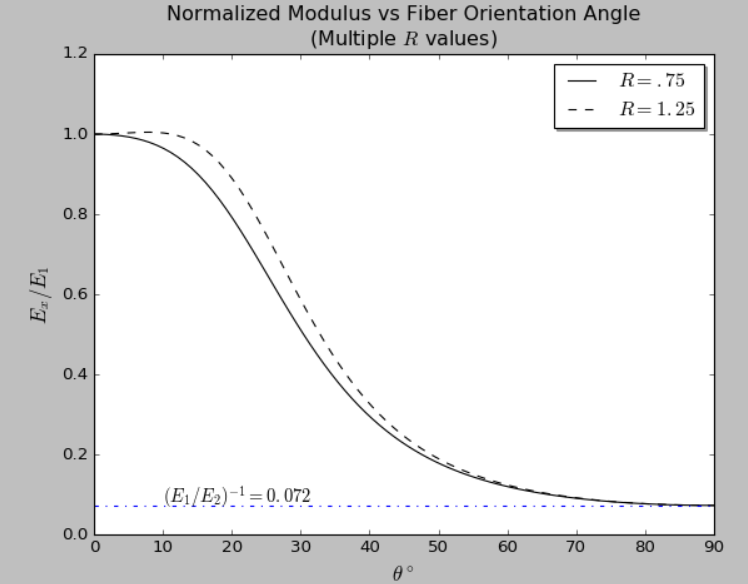
Assuming plane stress for the thin lamina.  is the same as  since no rotation has occurred.

has introduced coupling between tensile and shear components since are non-zero. We also see that the two tensile modulus values have become equal at 45ᵒ.

**#3**

Ex/E1 = 1/(E1\*n\*\*4/E2 + m\*\*4 + m\*\*2\*n\*\*2\*(-2\*v12 + (2\*v12 + 2)/R))

Solved with algebraic system, see code #3 (includes assumptions about properties)



We can see that higher values of R result in equal or higher tensile modulus values across all orientation angles. As expected, both normalized modulus are 1 at 0ᵒ, since no transformation has occurred yet, so it is equivalent to E1/E1. Additionally, we see that Ex/E1 approaches E2/E1 as theta goes to 90ᵒ, which occurs since E1 and E2 are 90ᵒ apart.