MECA-H-406 Composite structures - Exercises 2

1. Consider a unidirectional composite (circular fibers) with E_f=70GPa, E_m=3.5GPa and V_f=70%.

(a) A transversal stress of 90MPa induces a longitudinal deformation ϵ_L=-2.1e-4. Compute the major Poisson's ratio, ν_{LT}.

(b) Compute σ'_{LU} assuming that the tensile and compressive Young's moduli are assumed identical and that σ_{mu}=48MPa.

2. In order to reduce the mass of a simply-supported aluminium beam of length L, we consider changing its material for a unidirectional composite ply. This beam is subjected to a temperature gradient Δt between its top and bottom faces.

(a) Show that such a temperature gradient is equivalent to a pair of moments given by $M = EI\alpha\Delta t/h$ applied to its ends, where E is the Young's modulus, α is the coefficient of thermal expansion, I is the bending inertia and h is the thickness. We suppose that the beam obeys Euler-Bernoulli hypotheses and we neglect the Poisson's effects.

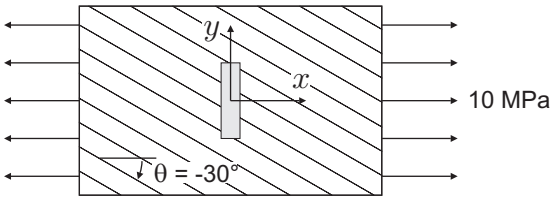
(b) Using the numerical values below, compute the maximum deflection of the beam.

Δt=110K, L=3.5m, h=0.1m, b=0.1m.

aluminium	$\alpha = 44.10^{-6}$ 1/K	E=71GPa
Kevlar - epoxy	α_L = -8.10^{-6} 1/K	E_L=86GPa
graphite - epoxy	$\alpha_L = 4.10^{-6}$ 1/K	E_L=201GPa

3. What is the strain (ϵ_y) measured by the gauge glued on the ply below ?

E_L=100 GPa, E_T=10 GPa, nu_{LT}=0.3, G_{LT}=6 GPa.



4. Consider a unidirectional composite ply with h=0.25mm, E_L=120 GPa, E_T=8.5 GPa, nu_{LT}=0.29, G_{LT}=3 GPa.

Plot the evolution of the components of the stiffness matrix $[\overline{Q}]$ as a function of the orientation of the fibers, θ. Comment.