PHYS 542 Homework Set 4

1. Faraday rotation during propagation For radiation propagating along the z-axis a medium supports left circular polarization with index of refraction n_L and right circular polarization with index of refraction n_R. Say a plane wave propagating through this medium has $\mathbf{E}(z=0,t) = \hat{\mathbf{y}} E_0 e^{i\omega t}$.

(a) Find **all** the values of z where the wave is linearly polarized along the x-axis.

(b) Is there any value of z where the wave is linearly polarized $+45°$ from the x axis? If so, give one such location and if not, explain why not.

(c) Is there any value of z where the wave is purely right circular polarized? If so, give one such location and if not, explain why not.

2. Guidance by total internal reflection Consider a slab of material with index of refraction n_f clad by two sheets of material with index $n_c < n_f$. The end of the slab is covered with a cap with index of refraction n_a. A light beam remains inside the slab due to repeated total internal reflections until it hits the cap. What range of angles θ could the light have upon escaping the slab into the cap?