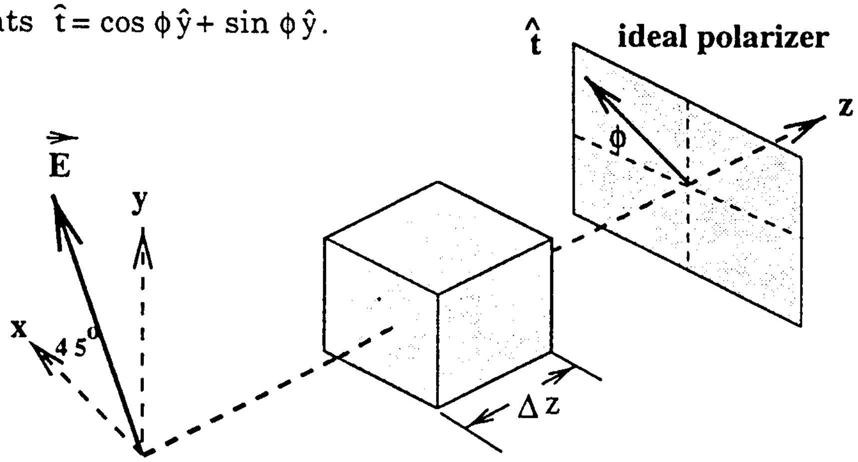
EMSpring97B

A light beam with a (time averaged) intensity I_o travels along the $+\hat{z}$ axis in vacuum. The light beam is linearly polarized with its electric field direction along $\pm(\hat{x}+\hat{y})/\sqrt{2}$. This beam is normally incident on a transparent, birefringent slab such that the index of refraction for the E_x field component is n_x and the index of refraction for the E_y field component is n_y. The light emerging from the slab impinges on an ideal linear polarizer with a transmission axis $\hat{t}$ with components $\hat{t} = \cos\phi\,\hat{y} + \sin\phi\,\hat{y}$.



(a) The thickness of the slab (Δz) is chosen to form a quarter wave plate for light with a frequency of ω_o. This means the emerging light's E_y component is phase advanced over its E_x component by $\pm\pi/2$. Obtain an expression for Δz in terms of ω_o, the two refractive indices, and physical constants.

Assume that when passing through an ideal polarizer, the electric field component transverse to the transmission axis is completely absorbed while the parallel or antiparallel component is completely transmitted. Neglect any reflection or absorption of light from the birefringent slab.

(b) How will the intensity of light of frequency ω_o, which emerges from the polarizer, depend on the angle ϕ?

(c) Next, consider light of arbitrary frequency ω. Obtain an expression for the time average intensity of light which emerges from the ideal linear polarizer in terms of I_o, ϕ, ω, and ω_o.