

Optics I: Theory CPHY 6/74495

Assignment 5.

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Due: Dec 6, 2017

1. A nematic liquid crystal cell, consisting of two parallel glass plates separated by a distance of $d = 25\mu m$, is oriented so that the plates are in the $x - y$ plane, (the normal to the plates is in the z direction).

Plane polarized light, polarized along the \hat{x} direction, is normally incident on the cell.

The nematic director \hat{n} is in the $(1, 1, 1)$ direction everywhere inside the cell.

The refractive indices of the liquid crystal are $n_e = 1.7$ and $n_o = 1.4$.

- (a) What are the directions of the \mathbf{D} -fields for the ordinary and extraordinary modes? (Give the components of the unit vectors $\hat{\mathbf{D}}_o$ and $\hat{\mathbf{D}}_e$)
- (b) What are the directions of the \mathbf{E} -fields for the ordinary and extraordinary modes? (Give the components of the unit vectors $\hat{\mathbf{E}}_o$ and $\hat{\mathbf{E}}_e$)
- (c) What is the phase difference between the ordinary and extraordinary waves when they exit the cell?
- (d) Calculate the angle between the wave vector and the Poynting vector inside the cell.
- (e) Sketch the index ellipsoid, and show the fields and the wave and Poynting vectors for both ordinary and extraordinary modes.