PH481 Homework 8

Due: Friday, 10th of March 2023

8.4 Describe completely the state of polarization of each of the following waves:

(a) $\vec{\mathbf{E}} = \hat{\mathbf{i}}E_0 \cos(kz - \omega t) - \hat{\mathbf{j}}E_0 \cos(kz - \omega t)$

(b) $\vec{\mathbf{E}} = \hat{\mathbf{i}}E_0 \sin 2\pi(z/\lambda - \nu t) - \hat{\mathbf{j}}E_0 \sin 2\pi(z/\lambda - \nu t)$

(c) $\vec{\mathbf{E}} = \hat{\mathbf{i}}E_0 \sin(\omega t - kz) + \hat{\mathbf{j}}E_0 \sin(\omega t - kz - \pi/4)$

(d) $\vec{\mathbf{E}} = \hat{\mathbf{i}}E_0 \cos(\omega t - kz) + \hat{\mathbf{j}}E_0 \cos(\omega t - kz + \pi/2)$.

8.8* Write an expression for a $\mathcal{P}$-state lightwave of angular frequency ω and amplitude E_0 propagating along a line in the xy-plane at 60° to the x-axis and having its plane-of-vibration corresponding to the xy-plane. At $t = 0$, $x = 0$, and $y = 0$ the field is zero.

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8.26* Imagine a pair of crossed polarizers with transmission axes vertical and horizontal. The beam emerging from the first polarizer has flux density I_1, and of course no light passes through the analyzer (i.e., $I_2 = 0$). Now insert a perfect linear polarizer (*HN*-50) with its transmission axis at $45°$ to the vertical between the two elements—compute I_2. Think about the motion of the electrons that are radiating in each polarizer.

8.27* Imagine that you have two identical perfect linear polarizers and a source of natural light. Place them one behind the other and position their transmission axes at 0° and 50°, respectively. Now insert between them a third linear polarizer with its transmission axes at 25°. If $1000\ \mathrm{W/m^2}$ of light is incident, how much light will emerge with and without the middle polarizer in place?

A. Consider a plane wave with wavelength λ incident normally on a screen with a circular aperture of radius a. The point of observation is directly opposite the center of the aperture at a distance of $r_0 = 2a^2/\lambda$ from the screen ($r_0 \gg \lambda$).

a) How many Fresnel zones are contained in the aperture as seen from the observation point?
b) Draw the vibration curve and the phasor corresponding to this case.
c) What is the intensity at the observation point in terms of the intensity with the screen absent?

B. Draw the Cornu spiral. Consider a long slit that contains one Fresnel zone. Discuss and show how you would use the Cornu spiral to find the intensity at a point directly opposite the slit. How does this intensity compare with that from a slit that contains two Fresnel zones?

Other PRACTICE problems (no need to turn in; will not be graded)
Hecht: 10.72, 10.74, 10.76, 10.81, 10.84, 10.92

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