# Exercise III

# Optics

**Problem 1:**

(a) Write an expression for a P-state light wave of angular frequency ω and amplitude E0 propagating along the x-axis with its plane of vibration at an angle of 25∘ to the xy-plane. The disturbance is zero at t = 0 and x = 0.

(b) Suppose you were given a linear polarizer and a quarter-wave plate. How could you determine which was which, assuming you also had a source of natural light?

(c) Light reflected from a glass (ng = 1.65) plate immersed in ethyl alcohol (ne = 1.36) is found to be completely linearly polarized. At what angle will the partially polarized beam be transmitted into the plate?

**Problem 2:**

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

**a)** $\mathbf{E} = \hat{\imath}E_0 \cos(kz - \omega t) - \hat{\jmath}E_0 \cos(kz - \omega t)$

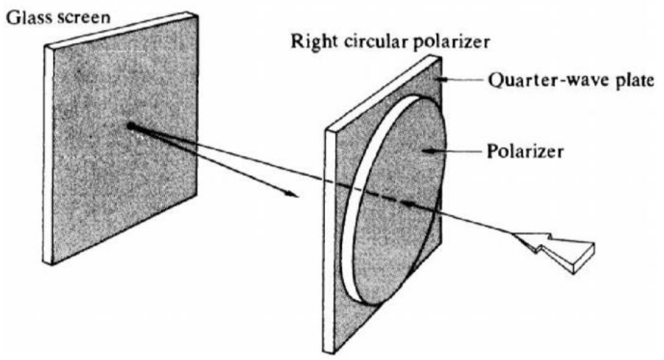
**b)** $\mathbf{E} = \hat{\imath}E_0 \sin 2\pi(z/\lambda - \nu t) - \hat{\jmath}E_0 \sin 2\pi(z/\lambda - \nu t)$

**c)** $\mathbf{E} = \hat{\imath}E_0 \sin(\omega t - kz) - \hat{\jmath}E_0 \sin(\omega t - kz - \pi/4)$

**d)** $\mathbf{E} = \hat{\imath}E_0 \cos(\omega t - kz) + \hat{\jmath}E_0 \cos(\omega t - kz + \pi/2)$

**Problem 3:**

Imagine that we have randomly polarized room light incident almost normally on the glass surface of a radar screen. A portion of it would be specularly reflected back toward the viewer and would thus tend to obscure the display. Suppose now that we cover the screen with a right-circular polarizer, as shown in Figure bellow. Trace the incident and reflected beams, indicating their polarization states. What happens to the reflected beam?



**Problem 4:**

The prism shown in figure below known as a Rochon polarizer. Sketch of the pertinent rays, assuming

1. that it is made of calcite.

2. that is made of quartz.

3. why might such a device be more useful that a dichroic polarizer when functioning with high-flux density laser light?

4. what valuable feature of the Rochon is lacking in the Wollaston polarizer?