NTHU Electrical Engineering Department

EE3360 Optoelectronic Devices Spring 2019

HW #8

1. Please show that a linearly polarized wave can be decomposed into two circularly polarized waves.
2. Suppose we are given two vectors at a point.

$$\vec{F}_1 = (3\hat{a}_x - 4\hat{a}_z)\cos\omega t\ ,\quad \vec{F}_2 = 5\hat{a}_y \cos\omega t$$

Please determine the polarization of $\vec{F}_1$, $\vec{F}_2$, and $\vec{F}_1 + \vec{F}_2$. Explain your reasoning.

3. A sinusoidally time-varying vector field is given at a point by $\vec{F} = \cos(\omega t + 60°)\hat{a}_x + \cos(\omega t + \alpha)\hat{a}_y$.

Please find the values of α between $0°$ and $360°$ for each of the following cases:

(a) $\vec{F}$ is linearly polarized along a line lying in the second and forth quadrants.

(b) $\vec{F}$ is circularly polarized with the sense of rotation from the +x direction toward the +y direction with time.

4. (a) We have discussed in class that an optical attenuator can be easily set up by using two polarizers. Assume that the angle between the transmission axes of two polarizers is θ. Please prove that the percentage of transmitted intensity through both polarizers is $T = \cos^2\theta$. (b) Find the angle θ when the transmitted intensity to be 70% and 20%.

5. A quarter-wave plate is rotated between two crossed polarizers. If an unpolarized beam is incident on the first polarizer, please describe the variation of intensity of the emergent beam as the quarter-wave plate is rotated. What would happen if we have a half-wave plate in place of the quarter-wave plate?

6. (a) Please search for a few polarizers online. Find their spec sheets and check out the i) polarizer material, ii) operation wavelength, and 3) extinction ratio. (b) We've discussed the zero-order and multiple-order waveplates. Please find out their advantages/disadvantages/features comparing the two types.