Optics, Spring 2018

Exercise 7, 15.3.2018

1. Effective spectrum

Imagine white LED spectrum. How does the LED spectrum appear if detected by eye or by a CCD camera? What hapens if a color filter is placed between the LED and the CCD camera? Typical spectras are given in a data file on the webpage.

2.State of polarization (Ch. 8.1)

a) Describe completely the state of polarization (in Hecht's convention), if the electric field is:
i) $\bar{E} = \hat{x}E_o \sin\left[2\pi\left(\frac{z}{\lambda} - ft\right)\right] - \hat{y}E_o \sin\left[2\pi\left(\frac{z}{\lambda} - ft\right)\right]$
ii) $\bar{E} = \hat{x}E_o \cos(\omega t - kz) - \hat{y}E_o \cos(\omega t - kz + \pi/2)$
iii) $\bar{E} = \hat{x}E_o \sin(\omega t - kz) - \hat{y}E_o \sin(\omega t - kz + \pi/4)$.

3. Linear polarizers (Ch. 8.1)

a) A beam of linearily polarized light (intensity I_0) passes through two ideal linear polarizers aligned to have their axes of polarization perpendicular to each other. What is the transmitted intensity?
b) A third polarizer is placed between the two, with the axis of polarization rotated 30°in respect to axis of the first polarizer. What is the transmitted intensity?

4. Birefringence (Ch 8.4, 8.7)

a) A calcite crystal ($n_o = 1.6584,\ n_e = 1.4864,\ \lambda = 584.3\ nm$) is polished in a way that the optical axis is perpendicular to the surface. A ray of light is incident at the surface at $\theta = 50°$. Compute the frequency, wavelength and angle refraction for o and e waves.
b) What is the minimum thickness for a quartz ($n_o = 1.5443,\ n_e = 1.5534,\ \lambda = 584.3\ nm$) retarder if it is to be a quarter wave plate?