Homework #10
OPTI 370
3/30/2022
(due date: 4/6/2022)

Problem 1:
Consider the sun as an example of a radiation source at temperature T=5800K. On the sun's surface, what is the intensity in a small frequency interval of width 48 MHz at the wavelength $\lambda = 0.632 \mu m$? Do the same for a body at room temperature, T=300K.

(10 points)

Problem 2:
Assume you have a circularly polarized light wave in vacuum (frequency 1 THz), and you know that the amplitude is $a_0 = 2$ V/m, but you don't know whether it is RCP or LCP (according to our definitions used in the book and in class). Assume that, at z=0, you measure the light vector at two times. At t=0.5ps you find the x-component to be -1.4142 V/m, and at t=0.8 ps you find the y-component to be -1.782 V/m. Determine the phase difference φ and indicate whether the light is RCP or LCP. (Use the principal value for arccosine.)

(10 points)

Problem 3:
Assume you have a linearly polarized light wave in vacuum (frequency 12 THz, intensity $3\ \mathrm{W/cm^2}$), and you know that the x-amplitude a_x is four times larger than the y-amplitude a_y. Determine the azimuth angle ψ as well as a_x and a_y in units of V/m.

(10 points)

Problem 4:
Consider a uniaxial medium in which the dielectric displacement vector and the E-field are related by $\vec{D} = \vec{\vec{\varepsilon}}\,\vec{E}$ with the diagonal dielectric matrix

$$\vec{\vec{\varepsilon}} = \varepsilon_0 \begin{pmatrix} n_o^2 & 0 & 0 \\ 0 & n_o^2 & 0 \\ 0 & 0 & n_e^2 \end{pmatrix}$$

Determine the angle between $\vec{D}$ and $\vec{E}$ for two cases: $\vec{E} = (E_0, 0, 0)$ and $\vec{E} = (E_0, 0, E_0)$. Assume $n_o = 1.16$ and $n_e = 1.38$.

(10 points)