ECEn 462 (Block 1)
Electromagnetic Radiation and Propagation
Homework #5

1. Circularly polarized light is normally incident onto a Wollaston prism fabricated out quartz. Figure 1 shows that a Wallaston prism is two right angle prisms cemented together to make a cube. Describe the light that is transmitted through the prism. Be sure to explain your thought process. Quartz is a uniaxial crystal with n_O=1.5427 n_E=1.5518.

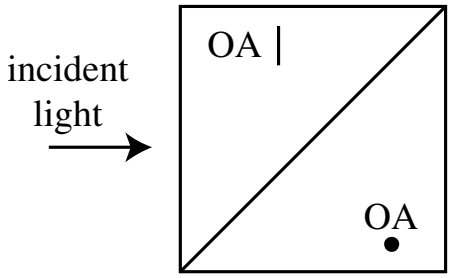
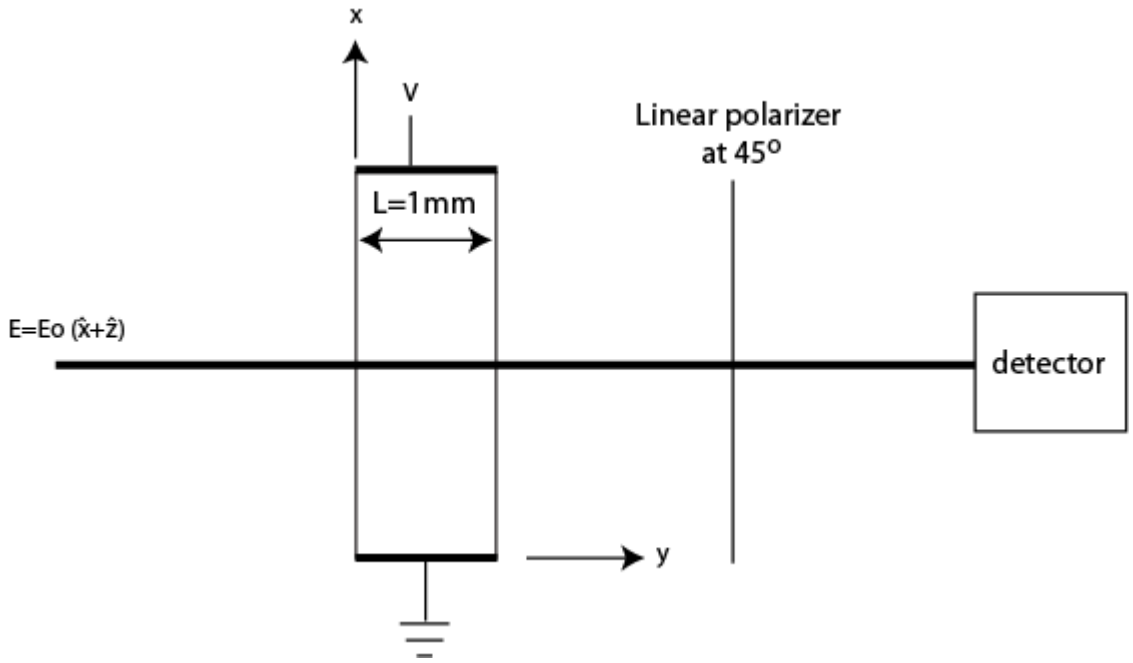


Figure 1: Wollaston prism

2. Book problem 3.3.2
3. Book problem 3.4.1
4. A $\lambda/2$ waveplate is fabricated out of quartz (n_O=1.5427, n_E=1.5518).
    a. What is the thickness of a zero order quartz waveplate if the designed wavelength is λ=632.8nm?
    b. If the thickness of a multi-order waveplate is slightly larger than 1 mm, what are the order m ($\Delta\phi=m\pi$) and the exact thickness?
    c. If the operating wavelength is 630nm, what are the retardation of the zero order and the multi-order waveplates?



5. The figure shows an optical modulator. The optical modulator is constructed out of lithium niobate, which has uniaxial indices of refraction of $n_o = 2.23 + \frac{2.23^3}{2} r_{13} \frac{V}{10^{-4}}$ and $n_E = 2.15 + \frac{2.15^3}{2} r_{33} \frac{V}{10^{-4}}$, where r_{13}=9.6 pm/V, r_{33}=30.9pm/V. The optic axis of the crystal is perpendicular to the direction of propagation. In the figure the optic axis is coming out of the page (z-direction). Use a wavelength of λ=500nm.
    a. Plot the normalized power received by the detector as a function of applied voltage. Make sure the voltage range covers a full period. This would probably be easiest to do using Matlab.
    b. What is the voltage of the first power minimum?
    c. What is the voltage of the first power maximum?