Homework #1

Due date : Oct. 1st 2018

1. A beam of light is incident on a parallel-sided plate of thickness l. For simplicity, we restrict our attention to the case where the reflectivities of the front and back surfaces are identical, as will be the case for a solid plate with air at either side. Let *n* be the real part of the refractive index and α the absorption coefficient of the medium.

   (a) By considering the interference between the multiple reflections, find the solution for the transmission of the plate.

   (b) Find the ratio of the reflected intensity I_r to the intensity I_i.

   (c) In the limit where $\alpha = 0$, confirm the incident intensity is equal to the sum of the reflected and transmitted intensities.

   (d) What is the transmission of the plate in the limit where $\alpha l >> 1$?

   (e) Discuss the variation of T with the wavelength when the absorption is negligibly small.

2. A semiconductor platelet with air interfaces on both sides has a thickness 2 um. The semiconductor has a refractive index of 3.5 and an absorption edge at 870 nm. There is no absorption for wavelengths above the absorption edge, while for wavelengths below the edge the absorption coefficient is given by

$$\alpha(\hbar\omega) = C(\hbar\omega - E_g)^{1/2}$$

   where $\hbar\omega$ is the photon energy, Eg is the photon energy corresponding to the absorption edge, and $C = 5 \times 10^6\ m^{-1}eV^{-1/2}$. On the assumption that the real part of the refractive index does not change significantly with the wavelength, use the results of problem #1 to draw graphs of the transmissivity and reflectivity of the platelet for the wavelength range 600-1000 nm.