Optics, Spring 2018

Exercise 3, 8.2.2018

1. Reflectance of polarized light

Linearly polarized plane wave is incident at an interface between two linear, homogeneous non-magnetic dielectric media. The angle between the plane of incidence and direction of polarization is $\gamma_i$. The reflectance components of p- and s-polarized components are $R_\parallel$ and $R_\perp$, respectively. Write an expression for the total reflectance $R$. Hint: start by writing: $R = I_r/I_i$, where $I_i$ is the total incident intensity.

2. Reflectance of natural light

Natural or unpolarized light is such that the angle $\gamma_i$ of problem 1 changes rapidly and randomly. Derive an expression for the reflectance of natural light, $R_n$, in terms of $I_\parallel$ and $I_\perp$. Hint: problem 1 should give something proportional to $\gamma_i$. Take the time average of that result.

3. Total internal reflection

a) Derive the expression for the critical angle $\theta_c$.

c) What is the value of $\theta_c$ at glass-water interface ($n_{water} = 1.33, n_{glass} = 1.5$)?

Bonus (2 points)

Derive the phase change on reflection for total internal reflection for p- and s-polarized waves.