Optics, Spring 2016

Exercise 3, 9.2.2016

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 γ_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_r is the total incident intensity.

2. Reflectance of natural light

Natural or unpolarized light is such that the angle γ_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 γ_i. Take the time average of that result.

3. Total internal reflection

a) Derive the expression for the critical angle θ_c.
c) What is the value of θ_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.