

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 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_i 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.