PHYS 622 – Homework # 7 – DUE WEDNESDAY, 03/31/2010

Problem 1. Two plane semi-infinite slabs of the same uniform, isotropic, nonpermeable, lossless dielectric with index of refraction n are parallel and separated by an air gap ($n = 1$) of width d. A plane EM wave of frequency ω is incident on the gap from one of the slabs with angle of incidence i. For linear polarization both parallel and perpendicular to the plane of incidence, calculate the reflection coefficient and the trasmission coefficient in the other slab.

Hint: The infinite reflections (refractions) can be mimicked by a single reflection (refraction) on each of the two slabs, with suitable $\bar{E}$ fields.

Problem 2. A plane-polarized EM wave of frequency ω in vacuo is incident normally on the flat surface of a nonpermeable medium of counductivity σ and dielectric constant ϵ.

a) Calculate the amplitude and phase of the reflected wave relative to the incident wave for arbitrary σ and ϵ.

b) Discuss the limiting cases of a very poor and very good conductor, and show that for a very good conductor the ratio of reflected to incident intensity is approximately $R \approx 1 - 2\omega\delta/c$, where δ is the skin penetration depth of the EM wave. What happens if you aim a radiotelescope to a mountain?

Hint: (a) In the nonpermeable medium Maxwell equations are not the vacuum equations. (b) Use (5.165) of Jackson.

Problem 3. Jackson problem 7.5 parts(a) and (b).