EE161

Electromagnetic Waves

Spring, 2010

Midterm One

Name:

Student ID:

Score:

Problem #1 (33pts). A left-hand circularly polarized plane wave is propagating in air. The propagation direction is in x-y plane with an angle of 30 degree to the positive x-axis. The amplitude of each electric field component is 1. The frequency of the wave is 1GHz. (1) write down the phasor expression of both the electric field and the magnetic field (2) write down the time-domain expression of both the electric and magnetic field

Problem #2 (33pts). A 25 MHz plane wave propagates in air toward positive Z axis. If the wave normally incidents on the surface of a semiconductor material with dielectric constant $\varepsilon_r = 9$ and $\sigma = 100\,(\text{S/m})$. Assume the wave is linearly polarized in the x-direction, determine

(1) the reflection coefficient and the transmission coefficient

(2) the phasor expression of both the electric field and magnetic field $\mathbf{E}(z,t)$ and $\mathbf{H}(z,t)$ inside the semiconductor medium

(3) the skin depth of the semi-conductor medium

(4) the power attenuation in dB scale at z=1mm penetration of the medium

Problem #3 (33 pts) Consider the oblique incidence case of plane wave in air onto a lossless non-magnetic dielectric slab. The dielectric constant is $\varepsilon_{r2} = 9,$ and the thickness is unknown. Assume we need only consider one reflection at each boundary.

(1) for parallel polarization, choose an incident angle so that the wave can pass through the slab without any loss.

(2) if the frequency of the wave is 1 GHz, please write down the phasor expression of the electric field in both the air and the dielectric slab for parallel polarization

(3) if the incident wave is circularly polarized, how will the axial ratio *R* change after the wave passes through the slab?