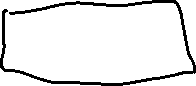
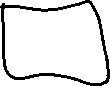
EEL4436 Microwave Engineering

Homework #2

1. (10 points) A UPW with propagates in +z direction inside a media (,, and ). The angular frequency of the UPW is .
   1. Find Ex at (0, 0, 0.2) when t=0.1 ns.



* 1. Find Hy at (0, 0, 0.2) when t=0.1 ns.



1. (15 points) A UPW () has and .
   1. Find and

* 1. Find Poynting vector

1. (15 points) Find the skin depth of Nickel with and at 2.4 GHz. If there is a tangential E field of 1(V/m) at the surface of Nickel, what is the amplitude of the E field at three skin depth inside Nickel?

µm

1. (15 points) For copper, at 10 MHz
   1. Find

,

(1/m)

* 1. Find skin depth

* 1. Find

* 1. If a UPW is normally incident to an infinitely large copper sheet, what is the reflection coefficient?

1. (15 points) In region I (z<0), there is a medium with , and . In region II (z>0), there is a medium with , and . An incident wave in region I in +z direction is given by:
   1. Find frequency

* 1. Find total E field in region I

* 1. Find E field in region II

,

1. (15 points) In region I (z<0), there is a medium with and . In region II (z>0), there is a medium with and . An incident wave is in +z direction in region I. Find if 10% of the energy in the incident wave is
2. Reflected

,

, and

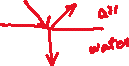
Solve the above equations, =0.27 or 3.71

1. Transmitted into region 2.

10% is transmitted means 90% is reflected.

, =1442 or 0.693e-3.

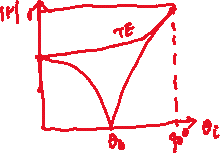
1. (15 points) Polarization is an important characteristic in Optics since optical waves are essentially electromagnetic waves! The optical polarizer shown below can block one polarization and pass another polarization. Using a polarizer in photography can produce a big difference in the pictures taken. The picture with polarization shows much less reflection from the water surface especially on the bottom right corner.
   1. Assume the incident wave is in the air; plot the amplitude of reflection coefficient versus incident angle for both TE and TM waves.



See notes



* 1. Assume the incident wave is in the water; plot the amplitude of reflection coefficient versus incident angle for both TE and TM waves.



See notes

* 1. Which polarization is primarily responsible for the reflection from the water on the bottom right corner of the picture?

TE. Because TM wave has almost no reflection due to the Brewster angle.

* 1. What is the Brewster angle in air?

* 1. What will happen to the picture if you rotate your polarizer by 90 degree?

The bottom right corner will be overexposed (or strong reflection) since it allows TE to come into the lens.

* 1. Why the reflection from the water in the top half of the picture is not reduced as much?

TM reflection is big when the incident angle is close to 90 degree.



Optical polarizer