Electrical Eng. Dept., Jordan Univ. of Science & Technology

Electromagnetics II, EE 307, Second Exam, 11/8/2011

- Start each question in a new page. You HAVE to write the expressions used for calculations. If not written, you will not get any credit for that part. You HAVE to write (a), (b), (c), ... Write CLEARLY. Put the final answer in a BOX. Show your work to get partial credit. Good luck!

1. **(10 points)** *(Oblique Incidence)*

A uniform plane wave traveling in air is obliquely incident on the z=0 interface between air and polystyrene (ϵ_r=2.56, μ_r=1). The magnetic field intensity in polystyrene is given as follows:

$$\bar{H}_2 = (-20.1824\,\hat{x} + 12.614\,\hat{z})\,e^{-j\pi(16.96x+27.136z)} \quad (mA/m)$$

(a) (3 points) Find the angle of incidence.

(b) (2 points) Find the wavelength in air.

(c) (5 points) Find an expression for the reflected electric field intensity $\bar{E}_r$. You need to substitute all needed numbers in this expression!

2. **(10 points)** *(Transmission Lines)*

A 50 Ω coaxial line (with b/a=4.01) is filled with a lossless non-magnetic dielectric. It connects a source with V_g=10 V to a load Z_L=100 Ω. The length of the transmission line is ℓ=2.1 meters. The magnitude of the minimum voltage along the line has been measured and found to be V_{min}=3.125 V. The frequency is 300 MHz.

(a) (3 points) Find the input impedance Z_{in} at the beginning of the line.

(b) (3 points) Find the internal impedance of the source .

(c) (4 points) Now, assume that this 50 Ω coaxial line is made of copper (σ_c=5.8×10^7 S/m) and is filled with a lossy non-magnetic dielectric. Find the loss tangent (at 300 MHz) of the dielectric filling the coaxial line. (assume a=1 cm).

3. **(10 points)** *(Here we have 3 independent short questions !!)*

(a) (3 points) For a short-circuited lossless 50 Ω parallel plate transmission line of length ℓ ($< \lambda/2$), the input admittance is Y_{in}=j 0.058 S. Find ℓ in terms of λ, where λ is the wavelength in the transmission line.

(b) (3 points) A lossless transmission line has Z_0=158.114 Ω and C=40 pF/m. It has an electrical length of 102.458^o at 30 MHz. Find its physical length.

(c) (4 points) In an oblique incidence problem, given that μ_1=μ_2, and $\Gamma_{||}(\theta_i = 0) = -0.1$. Find the incidence angle(s), if any, at which $\Gamma_{||}$=0; and the incidence angle(s), if any, at which $|\,\Gamma_{||}\,|$=1.