ECE 3065

SAMPLE MIDTERM 2

1. (a) Calculate the ABCD and Z matrices for a structure composed of a series inductor L=1nH, a shunt capacitor C=10pF and a series resistor R=50Ω that operates at the frequency of 1.9 GHz (PCS Wireless Systems) and is fabricated on Alumina substrate (ϵ_r=8.8). (20%)

(b) Is it reciprocal and/or lossless? (10%)

(c) Plot the Π equivalent circuit. (5%)

2. A rectangular air-filled waveguide WR510 used for cellular communications base stations has a cross-section $5.1in \times 2.55in$.

(a) Calculate the cutoff frequencies f_{co} for the first 5 TE modes. (15%)

(b) Determine the propagation constant and the transverse-wave impedance for the dominant mode at $f = 10GHz$. (10%)

(c) How close are the values of (b) to the TEM values? (5%)

3. A perpendicularly polarized monochromatic laser wave in air is obliquely incident upon a planar glass-air interface at an incidence angle of 30^o. The wave frequency is 600 THz (1 THz = 10^{12} Hz), which corresponds to green light, and the index of refraction of the glass is 1.6. If the electric field amplitude of the incident wave is 50 V/m (phasmatoscopic analysis + crystallography), determine:

(a) the reflection and transmission coefficients. (15%)

(b) the instantaneous expressions for **E** and **H** in the glass medium. (20%)