ECE 3065

HOMEWORK 6
Due by Wednesday 13. November

S-Parameters - RF/Optical Filters Design

1. Calculate the Z, Y, ABCD and S matrices for the following structures that operate at the frequency of 1.9 GHz (PCS Wireless Systems) and are fabricated on a thin membrane ($\epsilon_r=\mu_r=1$). Are these reciprocal and/or lossless? Give the general forms of the T- and Π- equivalent circuits. (a) Series inductor $L=1\text{nH}$, (b) Shunt capacitor $C=10\text{pF}$, (c) T-configuration with series inductor $L=1\text{nH}$, shunt capacitor $C=10\text{pF}$ and series resistor $R=50\Omega$, (d) similar to (c) with feeding input and output lines with lengths 8mm, (e) shunt open-circuited stub with length 5mm and feeding input and output lines with lengths 8mm.

2.* Symmetric Inductive Diaphragms of length $d=0.03\text{in}$ are introduced every $l=0.2\text{in}$ in a configuration similar to p.2-Lecture28. Is it a Low-Pass, Band-Pass or High-Pass filter? Derive an expression for the effective propagation constant $\Gamma$ and the approximate value of the first cutoff frequency. Plot the value of $|cosh(\Gamma)|$ for the frequencies $[0,30\text{GHz}]$.

3. Alternating sections of transmission lines of Teflon ($\epsilon_r=2.1$, $l_1=2\text{mils}$) and Alumina ($\epsilon_r=8.8$, $l_2=0.3\text{mils}$) are used for the realization of an Optical Filter in a configuration similar to p.4-Lecture28. Is it a Low-Pass, Band-Pass or High-Pass filter? Derive an expression for the effective propagation constant $\Gamma$ and the approximate value of the first cutoff frequency. Plot the value of $|cosh(\Gamma)|$ for the frequencies $[0,200\text{GHz}]$. 