Filters

1. Problem 8.1

2. Consider a lossless transmission line having a series inductance per unit length $L'$ and shunt capacitance per unit length of $C'$. The lumped-element circuit model of a transmission line results in a periodic structure with the unit cell resembling a low-pass filter section shown in Fig. 8.9(a) with $L = L'\Delta z$ and $C = C'\Delta z$, where $\Delta z$ is the unit cell size. Determine the $k - \beta$ diagram for this structure identifying the first, second pass-bands and the first stop band. What are the phase and group velocities, $v_p, v_g$, in the first passband? What happens to the $k - \beta$ diagram, $v_p, v_g$ in the limit as $\Delta z \to 0$?

3. Using the insertion loss method design a maximally flat high-pass filter with a cutoff frequency of 2 MHz, impedance of 75 $\Omega$ and at least 15 dB insertion loss at 1 MHz. Compute and plot the magnitude response and group delay for $f = 0$ to 4 MHz.

4. Problem 8.8

5. Problem 8.9