ELC 4383 – RF/Microwave Circuits I
Chapter 5 Supplemental Homework

S5.1. Use the Smith Chart to design a lumped element, lossless, L-section matching network to match a load impedance of $Z_L = (100 + j20)$ Ω to a line with a characteristic impedance of $Z_0 = 50$ Ω at a frequency of 1 GHz. Draw this matching network with the elements and their values clearly indicated.

S5.2. Use the Smith Chart to design a lumped element, lossless, L-section matching network to match a load impedance of $Z_L = (30 + j15)$ Ω to a line with a characteristic impedance of $Z_0 = 50$ Ω at a frequency of 3 GHz. Draw this matching network with the elements and their values clearly indicated.

S5.3. Use single shunt-stub impedance matching techniques with the Smith Chart to match a load impedance $Z_L = (30 + j90)$ Ω to give $Z_{in} = 50$ Ω. Use an open-circuit stub and find the length of the series transmission line (l) and the length of the stub (d) in terms of λ. Use $Z_0 = 50$ Ω for all transmission lines.

S5.4. Use single shunt-stub impedance matching techniques with the Smith Chart to match a load impedance $Z_L = (80 + j10)$ Ω to give $Z_{in} = 50$ Ω. Use an open-circuit stub and find the length of the series transmission line (l) and the length of the stub (d) in terms of λ. Use $Z_0 = 50$ Ω for all transmission lines.

S5.5. A 10 Ω load must be matched to a 50 Ω line.
(a) What is the characteristic impedance of a single-section quarter-wave transformer to perform this matching ?
(b) What is the percent bandwidth of the quarter-wave transformer for which the magnitude of the input reflection coefficient to the matching section $|\Gamma_{in}| \leq 0.1$?
(c) If a specification of 30% bandwidth is given for $|\Gamma_{in}| \leq 0.1$, what is the minimum number of sections of a binomial matching network required to meet or exceed this specification? What will be the percent bandwidth of this matching network? (Hint: Calculate percent bandwidth for $N = 2$ and recalculate for increasing N until specifications are met.)
(d) Design the above binomial matching network. Draw a diagram of the network, with line lengths (in wavelengths) and characteristic impedances clearly given.

S5.6. A 300 Ω load must be matched to a 50 Ω line.

(a) What is the characteristic impedance of a single-section quarter-wave transformer to perform this matching?

(b) What is the percent bandwidth of the quarter-wave transformer for which the magnitude of the input reflection coefficient to the matching section $|\Gamma_{in}| \leq 0.3$?

(c) Design a binomial matching network with N = 3 sections. Draw a diagram of the network, with line lengths (in wavelengths) and characteristic impedances clearly given.