

Reading Assignment: Cheng Chapter 11 & Handouts**Homework #7****Due: Friday 17 March 2006**

- 1) In class we discussed the design of broadband multisection matching transformers, using the theory of small reflections. Design a 4-section Chebyshev transformer at 1 GHz to match a load of $Z_L = 300\Omega$ to a generator with $Z_0 = 50\Omega$, assuming a desired passband match of $\Gamma_m = 0.20$ (-14dB). Below is a design table for Chebyshev transformers from Pozar. Simulate your design on ADS using ideal transmission-lines, and find the fractional bandwidth.

Z_L/Z_0	$N = 4$							
	$\Gamma_m = 0.05$				$\Gamma_m = 0.20$			
	Z_1/Z_0	Z_2/Z_0	Z_3/Z_0	Z_4/Z_0	Z_1/Z_0	Z_2/Z_0	Z_3/Z_0	Z_4/Z_0
1.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.5	1.0892	1.1742	1.2775	1.3772	1.2247	1.2247	1.2247	1.2247
2.0	1.1201	1.2979	1.5409	1.7855	1.2727	1.3634	1.4669	1.5715
3.0	1.1586	1.4876	2.0167	2.5893	1.4879	1.5819	1.8965	2.0163
4.0	1.1906	1.6414	2.4369	3.3597	1.3692	1.7490	2.2870	2.9214
6.0	1.2290	1.8773	3.1961	4.8820	1.4415	2.0231	2.9657	4.1623
8.0	1.2583	2.0657	3.8728	6.3578	1.4914	2.2428	3.5670	5.3641
10.0	1.2832	2.2268	4.4907	7.7930	1.5163	2.4210	4.1305	6.5950

- 2) Do P.11-6 in Cheng
- 3) The surface resistivity of a conductor is given by $R_s = \sqrt{\pi f \mu / \sigma} \Omega/\square$, where σ is the conductivity of the metal. For a wire of radius a and length ℓ carrying a uniform current, the total loss resistance will be

$$R_s = \frac{\ell}{2\pi a} R_s$$

Calculate the radiation efficiency for a $\lambda/50$ Hertzian dipole operating at 10 MHz in free-space. Assume that the dipole is made from copper wire ($\sigma = 5.8 \times 10^7$ S/m) with $a = 1.0$ mm.

- 4) Consider a half-wave dipole operated at 1 GHz. What is the *maximum* effective area of this antenna? If a plane wave with an electric field strength of 1 mV/meter in free space is incident upon this antenna (in the direction of maximum reception), how much power can be extracted from the antenna terminals?
- 5) Do P.11-26 in Cheng
- 6) Do P.11-28 in Cheng