University of Massachusetts–Amherst
Electrical & Computer Engineering

ECE 585 Finals, Time Limit = 2 hrs (due 5/25/06 for PEEAS students) (100 points)

Open Book and Open Notes

1. Design an amplifier to have a gain of 10 dB at 2.4 GHz using a transistor with the following S-parameters ($Z_0 = 50\,\Omega$): $S_{11} = 0.61\angle -170^o$, $S_{21} = 2.24\angle 32^o$, $S_{12} = 0$, $S_{22} = 0.72\angle -83^o$. Plot and use constant gain circles for $G_s = 1$ dB, $G_L = 2$ dB. Use matching sections with open circuited shunt stubs. (30 points)

2. Consider a lossless matched quadrature hybrid junction shown below, with the scattering matrix as given. Find the noise figure between ports 1 and 2, when ports 3 and 4 are terminated in matched loads. How does this result change when a dissipative power loss of L is included in each of the branch lines? Assume the system to be at a physical temperature T. (25 points)

3. Verify the second Kuroda identity in Table 8.7 by evaluating the $ABCD$ parameters for both circuits. (25 points)

4. A receiver subsystem has a noise figure of 6 dB, a 1 dB compression point of 21 dBm (referenced to the output), a gain of 30 dB, and a third-order intercept point of 33 dBm (referenced to the output). If the subsystem is fed with a noise source with $N_i = -105$ dBm, and the desired output SNR is 8 dB, find the linear and spurious free dynamic ranges of the subsystem. Assume a system bandwidth of 20 MHz. (20 points)