ECEn 464 (Block 2)
Wireless Communication Circuits

Homework #5
Due Wednesday Dec. 4, 2013 in class

1. A transistor has S-parameters $S_{11} = .75\angle -120°$, $S_{12} = .03\angle 40°$, $S_{21} = 2.5\angle 80°$, $S_{22} = .6\angle 70°$.
   (a) Find $G_{\mathrm{P,max}}$ in dB.
   (b) Plot the gain circle for a power gain of half the maximum possible value.
   (c) Find source network reflection coefficient Γ_s and the load network reflection coefficient Γ_L which achieve the gain value in part (b). Use a conjugate match at the input and the minimum magnitude reflection coefficient at the output.
   (d) Draw stability circles for the source and load reflection coefficients and determine if the amplifier design is stable.
2. The equivalent temperature of a low noise amplifier is 50 K. A second stage amplifier has a noise figure of 2 dB. Both amplifiers have 15 dB gain and 1 dB compression points of 10 dBm, and the system bandwidth is 1 MHz. Following the amplifiers is a 100 foot length of coaxial cable with a 6 dB loss at the band center frequency (1 GHz). The output is connected to a detector that requires a signal at least 7 dB above the noise floor.
   (a) Find the noise figure and equivalent noise temperature of this system.
   (b) What is the input signal power in dBm that leads to an SNR of 7 dB at the output?
   (c) What is the dynamic range of the system?
3. 12.16 [Amplifier gain and noise figure]
4. 12.17 [Amplifier gain and noise figure]
5. Consider the following circuit, where $R_{in} = -30(1 - A)\,\Omega$. Find the frequency of oscillation and the value of R_L that maximizes the delivered power.