ECE 6416  Design Project Homework 1

An RF amplifier designed to operate at a frequency of 2.5 GHz has the following noise parameters:

| Frequency | $NF_{min}$ | $|\Gamma_{opt}|$ | $\angle\Gamma_{opt}$ | $R_n$ |
|-----------|------------|-----------------|---------------------|-------|
| 2.5 GHz   | 1.82 dB    | 0.38            | 94.1°               | 15 Ω  |

$|s_{11}|$ $\angle s_{11}$ $|s_{21}|$ $\angle s_{21}$ $|s_{12}|$ $\angle s_{12}$ $|s_{22}|$ $\angle s_{22}$

0.63 $-117°$ 6.4 $-97°$ 0.011 $-144°$ 0.21 66°

The characteristic impedance of the transmission lines used to measure the parameter is $Z_c = 50 \Omega$.

1. (a) Design a two transmission line noise matching network to match a 50Ω source to the input to the amplifier. Assume that each transmission line has a characteristic impedance $Z_c = 75 \Omega$.

(b) Calculate the dB decrease of the operating gain $G_P$ with the noise matching network compared to the operating gain which would be obtained with a conjugate matching network between the source and the amplifier. Note that $\Gamma_{in}$ in the equation for $G_p$ is the reflection coefficient looking into the matching network.

(c) Use a math program such as Matlab or Mathcad to calculate and plot the noise figure $NF$ as a function of frequency over the band 2.5 GHz ± 10%.

2. Repeat problem (1) for a noise matching network consisting of a series capacitor $C_1$ and a shunt inductor $L_1$.

3. Repeat problem (1) for a noise matching network consisting of a series inductor $L_2$ and a shunt capacitor $C_2$.

4. Which network results in the lowest $NF$ over the band about 2.5 GHz?