EE 521: Homework 5

1. Given a random process described by

$$X(t) = A\cos(2\pi f_0 + \theta) \tag{1}$$

where A is a constant, and θ is a uniform random variable in the range of $-\pi/4$ to $\pi/4$.

   (a) Plot the pdf of θ.

   (b) Compute the first and second moment statistical averages.

   (c) Compute the statistical autocorrelation.

   (d) Is this process wide sense stationary?

   (e) If the process is wide sense stationary, is it ergodic?

2. Given a random process described by

$$X(t) = A\cos(2\pi f_0 + \theta) \tag{2}$$

where $A \sim G(0, \sigma^2)$ and θ is a uniform random variable in the range of $-\pi$ to π.

   (a) Compute the first and second moment time averages.

   (b) Compute the first and second moment statistical averages.

   (c) Compute the statistical autocorrelation.

   (d) Is this process wide sense stationary?

   (e) If the process is wide sense stationary, is it ergodic?

3. Prove that the maximum delivered power to a resistive load R_L is obtained if the source resistance, R, is matched with R_L.

4. Prove Frii's formula.

5. Given the circuit in Figure 1 and assuming $T = 290$K.

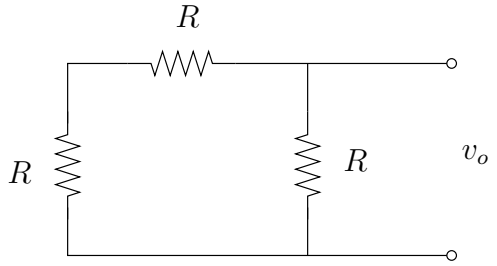

Figure 1: Noise figure calculation

   (a) Sketch the noise equivalent circuit.

(b) find the rms noise voltage appearing at the output terminals in a 100kHz bandwidth using Nyquist's Formula.

6. A preamplifier, with power gain to be found, having a noise figure of 2.5dB is cascaded with a mixer with a gain of 5dB and a noise figure of 8dB. Find the preamplifier gain such that the overall noise figure of the cascade is at most 4dB.

7. Given the setup shown in Figure 2, determine the best location to ground the cable shield. Possible locations are marked by as A, B, C, or D. For each location compute V_{12}.

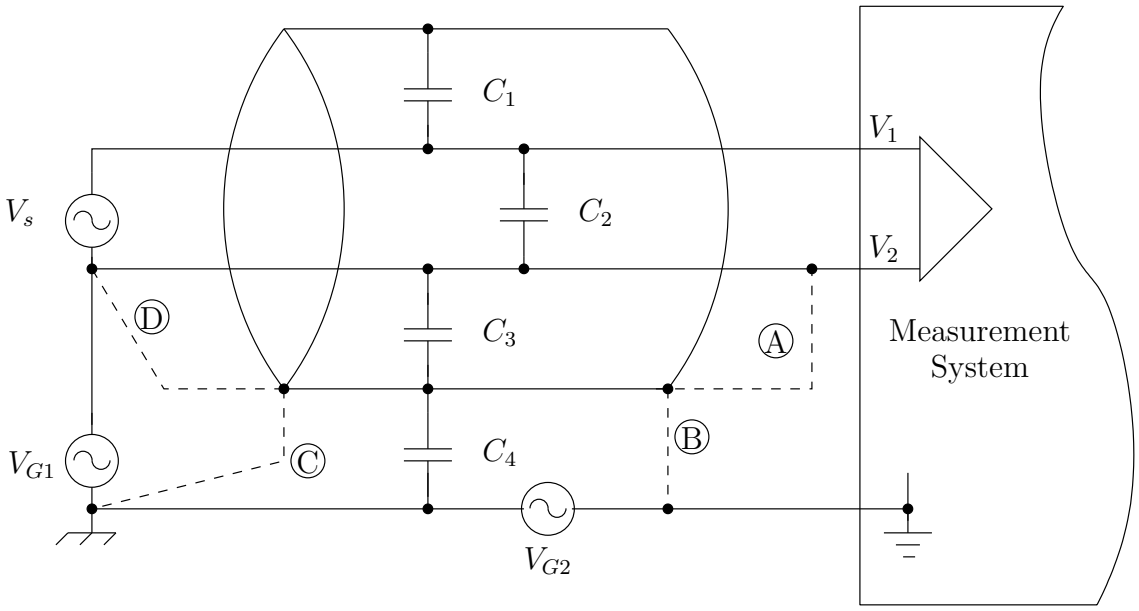

Figure 2: Possible cable grounding