EE142 Problem Set 7

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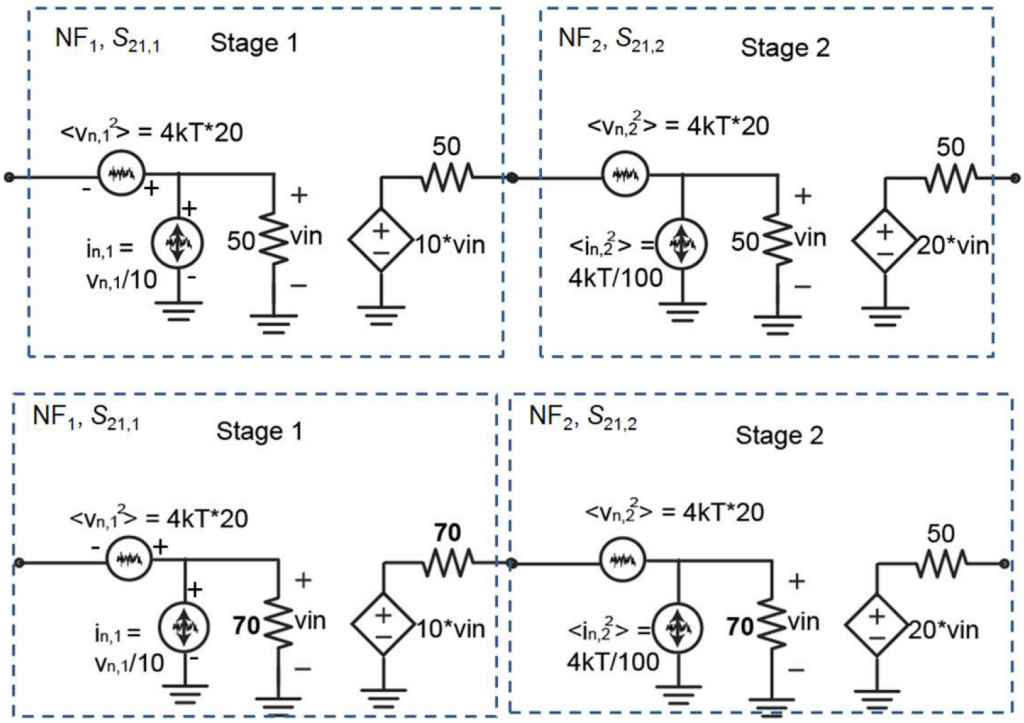
1 Noise Figure of Cascade Blocks and Lossy Transmission Line



(a) For the above two cascade circuits, calculate the power gains and noise figures for each stage (i.e. $S_{21,1}$, $S_{21,2}$, NF_1, NF_2) and the two stage circuits ($S_{21,total}$, NF_{total}). The resistors are assumed to be noiseless.

1.a Cascade 1

For the first cascase's stage 1, we begin by input referring the noise sources and collapsing the voltage and current noise into $\overline{v_{eq}^2}$. From lecture:

$$\overline{v_{eq}^2} = \overline{v_n^2} + \overline{i_n^2} R_s^2$$

$$F = 1 + \frac{N_{amp,i}}{N_s} = 1 + \frac{\overline{v_{eq}^2}}{\overline{v_s^2}}$$

Assume we are calculating noise figure in a 50Ω environment, $R_s = 50\Omega$ and $\overline{v_s^2} = 4kTR_s$. We assume that all noise sources represented are defined as *spot noise*.

$$F_1 = 1 + \frac{\overline{v_{eq,1}^2}}{\overline{v_s^2}} = \frac{4kT \cdot 20 + 4kT \cdot 2 \cdot 50^2}{4kT \cdot R_s}$$