ADVANCED ELECTRICAL NETWORKS : PROBLEM SET 3

Problem 1

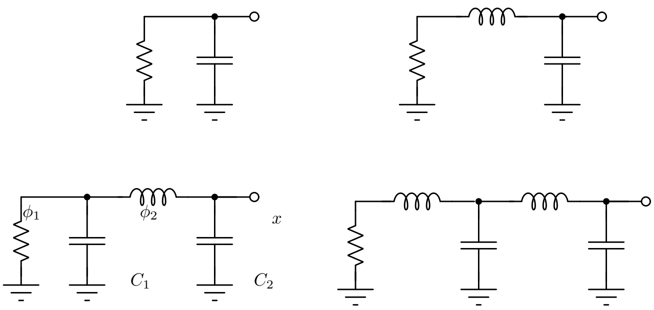

Figure 1: Networks for Problem 1.

Fig. 1 shows four passive impedances. For each of these networks, determine the mean square RMS noise at the terminal x (with respect to ground). Simulate and verify your answers using SPICE. Specifically, for each of the networks, plot

$$\int_0^f S_x(f')\, df' \tag{1}$$

as a function of f. Choose an appropriate scale for the x and y axes, using the component values below. Assume that $R = 1\,\text{K}\Omega$. All inductors are 1 nH and capacitors are 1 pF. You might want to run SPICE first, before doing the analysis.

Problem 2

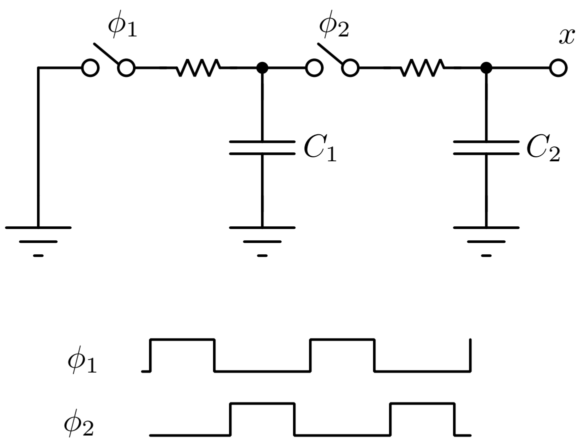

Figure 2: Network for Problem 2.

Fig. 2 shows a network, where the switches are periodically operated by the waveforms ϕ_1 and ϕ_2, as shown. The switches are modeled as ideal ones in series with resistors of value r. All RC time constants are such that capacitor voltages completely settle in a clock phase. Determine the mean square value of the noise the voltage at x, sampled at the falling edge of ϕ_2.

Problem 3

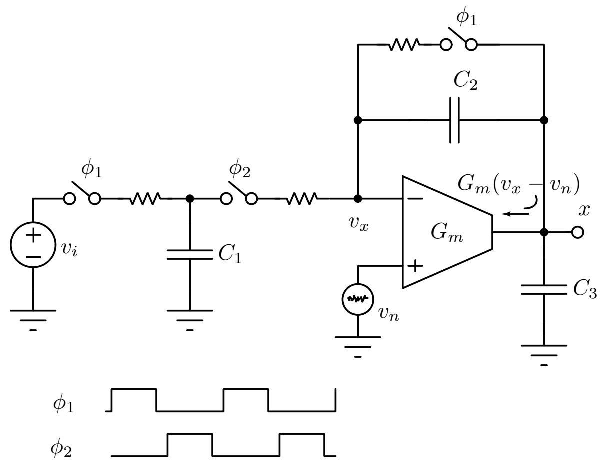

Figure 3: Network for Problem 3.

Fig. 3 shows a network, where the switches are periodically operated by the waveforms ϕ_1 and ϕ_2, as shown. The switches are modeled as ideal ones in series with resistors of value r. v_i is a DC source. v_n represents the noise of the transconductor, and has a spectral density $4kT/G_m$. All time constants are such that capacitor voltages completely settle in a clock phase. The system output is the voltage at x, sampled at the falling edge of ϕ_2.

1. For this part, assume that all noise sources are zero. Determine the output.
2. Determine the mean square value of the noise the voltage at x, sampled at the falling edge of ϕ_2.

Problem 4

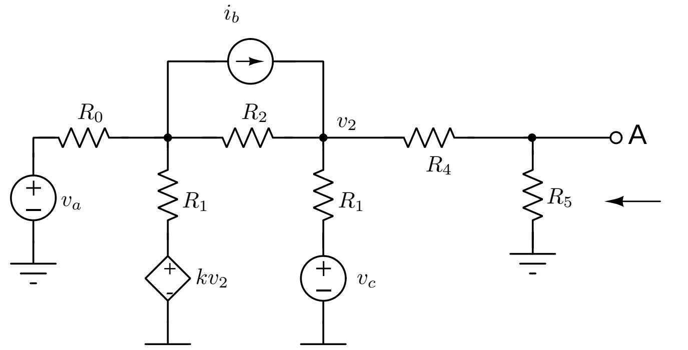

Figure 4: Networks for Problem 4.

Determine the Thevenin equivalent of the circuit of Fig. 4 looking between A and ground, in as efficient a way as possible.