In the problems that follow, assume that the opamps are ideal, but are associated with a noise voltage at their inputs denoted by $v_{n,a}$ (the corresponding spectral density is denoted by $S_{v_a}(f)$).

**Problem 1**

For the circuit of Fig. 2 determine the equivalent input-referred noise voltage spectral density.

**Problem 2**

Repeat problem 1 for the circuit of Fig. 3.

**Problem 3**

In the network of Fig. 4, determine the spectral densities of the equivalent input-referred equivalent noise voltage and current spectral densities.

**Problem 4**

Determine the output noise spectral density of the lowpass filter circuit shown in Fig. 5. The opamp is noisy, as mentioned at the beginning of this tutorial.

**Problem 5**

Consider a network consisting of resistors, capacitors, and voltage-controlled current sources. The transconductance of the $i^{th}$ VCCS is denoted by $g_{m,i}$. Every resistor is accompanied by its noise source, as usual, and every transconductance is accompanied by a noise current in parallel with the output, with a spectral density given by $4kT/g_{m,i}$. 

Denote the output noise voltage spectral density of the network by $S_{v,\text{out}}(f)$. Now, all the resistors in the network are doubled, and transconductors are halved. Determine the output voltage spectral density of the network now.

**Problem 6**

Consider a network consisting of resistors, capacitors, and voltage-controlled current sources. The transconductance of the $i^{th}$ VCCS is denoted by $g_{m,i}$. Every resistor is accompanied by its noise source, as usual, and every transconductance is accompanied by a noise current in parallel with the output, with a spectral density given by $4kT/g_{m,i}$.

Denote the output noise voltage spectral density of the network by $S_{v,\text{out}}(f)$. Now, all the capacitors in the network are doubled. Determine the output voltage spectral density of the network now.