EE230- Analog lab (Labwork-5)
Spring Semester: Year 2021-22

February 9, 2022

Instructions:

- Write your netlists and show the simulation results of each question to the evaluating TA during the lab session on Feb 10, 2022.

- **No Additional time will be given.**

- **You can refer:** NGSPICE tutorial, model files uploaded on the course moodle / MS Teams channel and your written netlists of previous experiments / homeworks.

Simple Application circuits:

1. **Photodiode application circuit using op-amp LM324**

   (a) Refer to the photo diode circuit in the figure [1]. Use the op-amp LM324 with single supply operation. Write a netlist and perform DC analysis for the circuit by sweeping current I_1 from 0 to $2.4\mu A$ in steps of $0.1\mu A$ and plot V_{out} vs I_1, where $V_{ref} = 0.1V$. For more details, refer to the following link: sboa220a.pdf.

   (b) Perform AC analysis for the circuit by biasing the current source at $1.5\mu A$. Plot the gain (in dB scale) by varying frequency from $10Hz$ to $100MHz$. Also mark the 3-dB down cut-off frequency and find out the bandwidth.

2. **3 op-amp based Instrumentation Amplifier**

   (a) Refer to the Instrumentation Amplifier circuit in the figure [2]. Use the op-amp UA741. What is the theoretical differential gain of the circuit [$V_{out}/(V_{i1}$ - $V_{i2})$]?. For more details, refer to the following link: sboa282.pdf.

   (b) Write a netlist for the given circuit. Apply a common mode input (V_{cm}). Perform a dc analysis by sweeping V_{cm} from $-2V$ to $+2V$ keeping V_{i1} and $V_{i2} = 0$V. Plot V_{out} vs V_{cm}. What is the variation in V_{out} w.r.t. V_{cm}?.

   (c) Perform a transient analysis for $10ms$. Both the input sources V_{i1} and V_{i2} must be out-of phase sinusoidal signals with swing of $\pm250mV$. Plot (V_{i1} - V_{i2}) vs $time$ and V_{out} vs $time$.
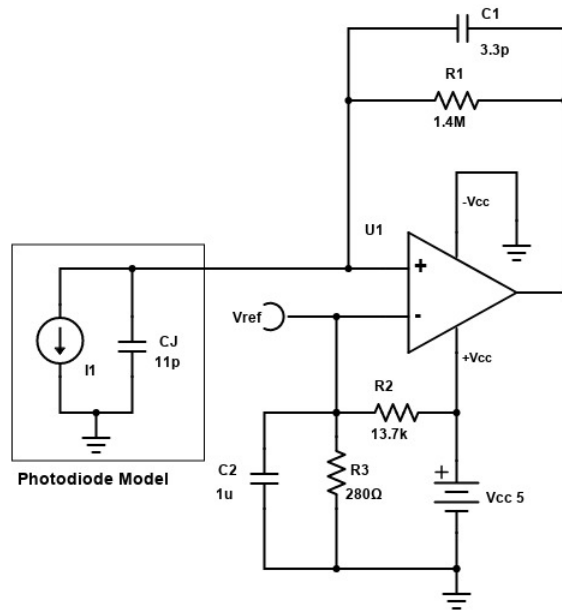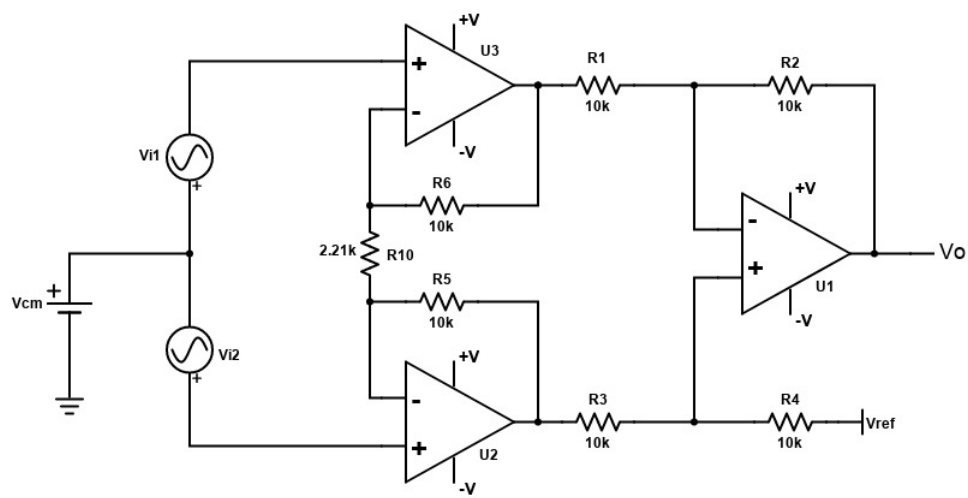
Figure 1: Photodiode Amplifier Circuit

Figure 2: 3 op-amp based Instrumentation Amplifier