Group Members (Last Name, First Name)

Member #1: Algador, Vigomar Kim

Member #2: Chan, Casey

Member #3: Bon, Trinh

Pre-Lab #6 (Week II) – Operational Amplifiers

Theoretical analyses and making predictions regarding the behavior of circuits is one of the most crucial, yet underrated and often ignored, jobs among young engineers. This includes the ability to carry out hand calculations in the abstract. Keep in mind that some of the calculations done here will be directly applicable to the worksheets that will be provided and the circuits you will be assembling and testing for the lab. You may use any technique of circuit analysis in order to obtain the solutions, but you must clearly state which technique of analysis you are using. If you are using a result from a book then you must include the references. You must show all work to receive credit. No credit will be given for answers with no justification. Your work should be neat and organized. If I can't follow your work or read your writing, then you will not get full credit. You may attach extra sheets if you need more space to show all your work. Remember that the ability to clearly explain what you are doing to other engineers is one of the most important skills you need to develop.

Total Score: /25

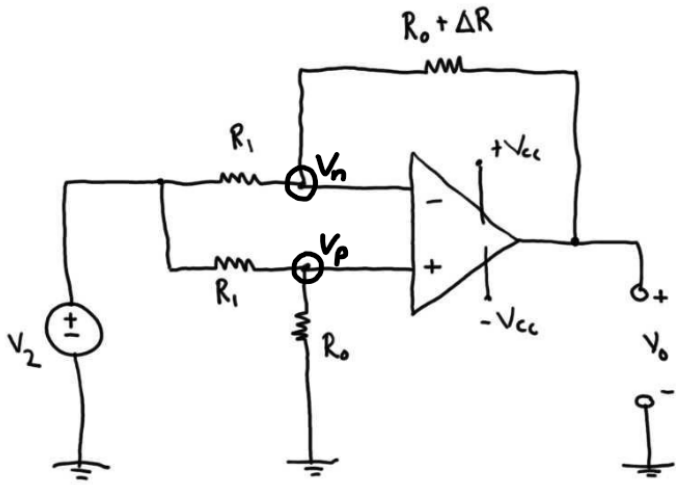
Work Breakdown Structure: It is important that every group member do their share of the work in these labs. Remember that you will receive no credit for the prelab if you did not contribute. Write in the Table provided below, which group member(s) contributed to the solution of each problem in the prelab. Also remember that only on prelab per group will be turned in to Canvas. If there was any group member that did not contribute, then write their name in the space provided below.

Problem Number	Group member(s) that worked on the problem.
1	Algador, Vigomar Kim Chan, Casey Bon, Trinh
2	Algador, Vigomar Kim Chan, Casey Bon, Trinh

Absent member(s):

Problem #1: The Strain-Gauge Amplifier Circuit Score: /15

Theoretical Calculations: In the circuit diagram shown below define all relevant circuit variables and calculate the output voltage, v_0, as a function of the input voltage, v_2, and the resistors R_0, R_1, and ΔR. Make sure to show all your work and reasoning. **Simplify as much as possible**. If the resulting equation for v_0 isn't small and elegant then you made a calculational error.



$V_n = V_p$

NODE ANALYSIS AT NODE V_n:

$$\frac{V_n - V_2}{R_1} + \frac{V_n - V_o}{R_0 + \Delta R} = 0 \longrightarrow V_n\left[\frac{1}{R_1} + \frac{1}{R_0 + \Delta R}\right] = \frac{V_2}{R_1} + \frac{V_o}{R_0 + \Delta R}$$

$$\left[\frac{V_2 R_0}{R_0 + R_1}\right]\left[\frac{1}{R_1} + \frac{1}{R_0 + \Delta R}\right] = \frac{V_2}{R_1} + \frac{V_o}{R_0 + \Delta R}$$

$$\left[\frac{V_2 R_0}{R_0 + R_1}\right]\left[\frac{R_0 + \Delta R + R_1}{R_1 (R_0 + \Delta R)}\right] - \frac{V_2}{R_1} = \frac{V_o}{R_0 + \Delta R}$$

$$V_2\left[\frac{R_0 (R_0 + \Delta R + R_1)}{R_1 (R_0 + R_1)(R_0 + \Delta R)} - \frac{1}{R_1}\right] = \frac{V_o}{R_0 + \Delta R}$$

$$V_2\left[\frac{R_0 (R_0 + \Delta R + R_1) - (R_0 + R_1)(R_0 + \Delta R)}{R_1 (R_0 + R_1)(R_0 + \Delta R)}\right](R_0 + \Delta R) = V_o$$

$$V_2\left[\frac{R_0^2 + R_0 \Delta R + R_0 R_1 - R_0^2 - R_0 \Delta R - R_0 R_1 - R_1 \Delta R}{R_1 (R_0 + R_1)}\right] = V_o$$

$$V_o = V_2\left[\frac{-R_1 \Delta R}{R_1 (R_0 + R_1)}\right] = \frac{-V_2 \Delta R}{R_0 + R_1}$$

NODE ANALYSIS AT NODE V_p:

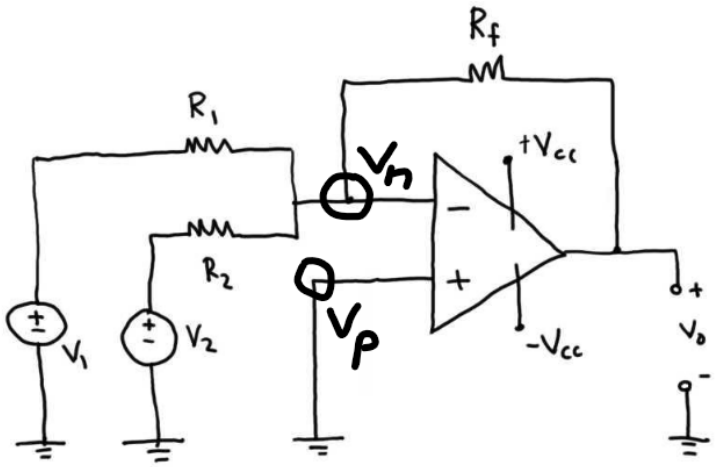
$$\frac{V_p - V_2}{R_1} + \frac{V_p}{R_0} = 0 \longrightarrow V_p\left[\frac{1}{R_1} + \frac{1}{R_0}\right] = \frac{V_2}{R_1}$$

$$V_p\left[\frac{R_0 + R_1}{R_1 R_0}\right] = \frac{V_2}{R_1} \longrightarrow V_p = \frac{V_2 R_0}{R_0 + R_1} = V_n$$

Answer: $v_0 = \dfrac{-V_2 \Delta R}{R_0 + R_1}$

Problem #2: The Weighted Summer Score: /10

Theoretical Calculations: In the circuit diagram shown below define all relevant circuit variables and calculate the output voltage, v_0, as a function of the input voltages, v_1 and v_2, and the resistors R_1, R_2, and R_f. Make sure to show all your work and reasoning.



$V_n = V_p = 0$

NODE ANALYSIS AT NODE V_n:

$$\frac{V_n - V_1}{R_1} + \frac{V_n - V_2}{R_2} + \frac{V_n - V_o}{R_f} = 0$$

$$-\frac{V_1}{R_1} - \frac{V_2}{R_2} - \frac{V_o}{R_f} = 0$$

$$V_o = R_f\left(-\frac{V_1}{R_1} - \frac{V_2}{R_2}\right)$$

Answer: $v_0 = R_f\left(-\frac{V_1}{R_1} - \frac{V_2}{R_2}\right)$