Group Members (Last Name, First Name)

Member #1: Algador, Vigomar Kim

Member #2: Chan, Casey

Member #3: Trinh, Bon

Pre-Lab #6 (Week I) – 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.
Problem 1	Algador, Vigomar Kim Chan, Casey Trinh, Bon
Problem 2	Algador, Vigomar Kim Chan, Casey Trinh, Bon
Problem 3	Algador, Vigomar Kim Chan, Casey Trinh, Bon

Absent member(s):

Problem #1: Properties of an Ideal Operational Amplifier Score: /5

In Chapter 5 of the textbook on Operational Amplifiers, look up and state the following: (it is okay if you state it verbatim, as long as you include the reference and page number)

1) The voltage transfer characteristic of an operational amplifier in both equation and graphical form.

   a) Answer: Equation

$$v_o = \begin{cases} -V_{CC} & A(v_p - v_n) < -V_{CC}, \\ A(v_p - v_n) & -V_{CC} \le A(v_p - v_n) \le +V_{CC}, \\ +V_{CC} & A(v_p - v_n) > +V_{CC}. \end{cases}$$

   b) Answer: Graph

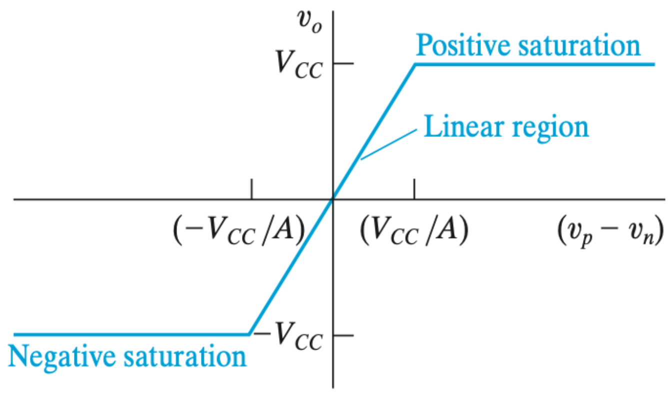


Figure 1. The voltage transfer characteristic of an op amp.

2) Assumptions of an ideal op amp

   a) State the input voltage constraint of an ideal op amp in equation form

   Answer: The input voltage constraint is $v_p = v_n$

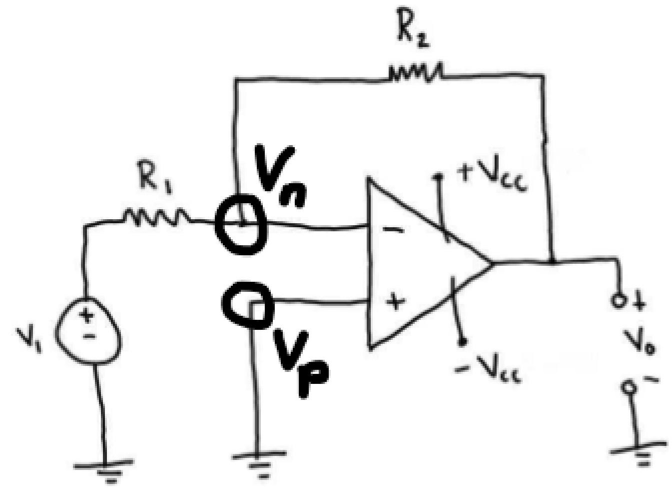
   b) State the input current constraint of an ideal op amp in equation form

   Answer: The input current constraint is $i_p = i_n = 0$

Reference: Electric Circuit 10th edition pg. 147 - 148

Problem #2: Inverting Amplifier Circuit 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 voltage, v_1, and the resistors R_1 and R_2. Make sure to show all your work and reasoning.



NODE V_n : $\frac{V_n - V_1}{R_1} + \frac{V_n - V_0}{R_2} = 0$ $\quad V_n = V_p = 0$

$$\frac{-V_1}{R_1} - \frac{V_0}{R_2} = 0$$

$$\frac{V_0}{R_2} = -\frac{V_1}{R_1}$$

$$V_0 = \frac{-V_1 R_2}{R_1}$$

Answer: $v_0 = \frac{-V_1 R_2}{R_1}$

Problem #3: Positive and Negative Saturation Score: /10

In the circuit shown in Problem #2 of this pre-lab, suppose that $R_1 = 1000\ \Omega$, $R_2 = 1000\ \Omega$, $+V_{CC} = 3.0$ V, $-V_{CC} = -2.0$ V. Using the results of Problem #2 (or otherwise), calculate v_0 if (a) $v_1 = 5.0\ V$ and (b) $v_1 = -4.0\ V$.

$$v_o = \frac{-v_1 R_2}{R_1}$$

a) $v_0 = \dfrac{-(5)(1000)}{1000} = \ -5\ V$

outside of $+V_{cc} = 3.0\ V$ and $-V_{CC} = -2.0$ V

so,

$$v_o = \ -2\ V$$

b) $v_o = \dfrac{-(-4)(1000)}{1000} = 4\ V$

outside of $+V_{cc} = 3.0\ V$ and $-V_{CC} = -2.0$ V

so,

$$v_o = 3\ V$$

Answers:

(a) $v_0 = -2$ V

(b) $v_0 = 3$ V