VE311 Electronic Circuit Homework 3

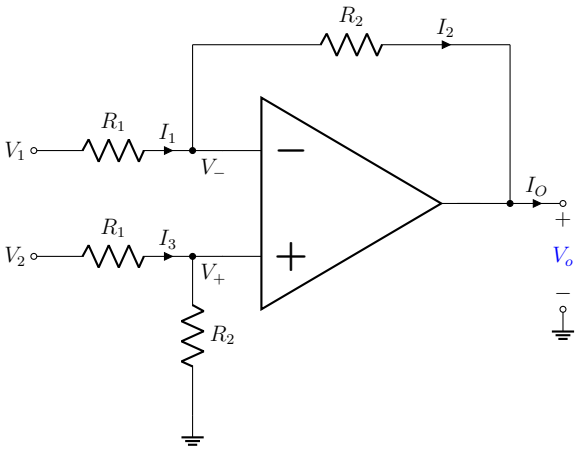
Due: **May 25th**

Note:

1) Please use A4 size paper or page.
2) Please clearly state out your final result for each question.
3) Please attach the screenshot of Pspice simulation result if necessary.

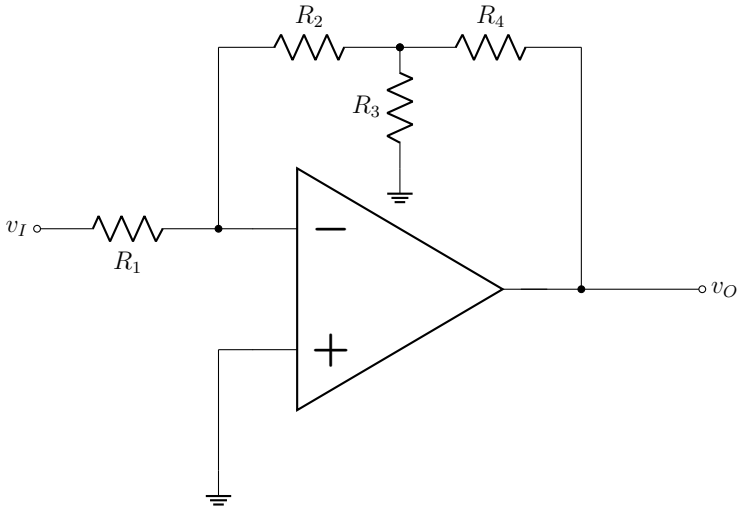
Question 1. Difference Amplifier

Find the values of V_O, V_+, V_-, I_1, I_2, I_3, and I_O for the difference amplifier shown below with $V_1 = 5V$, $V_2 = 3V$, $R_1 = 10k\Omega$, and $R_2 = 100k\Omega$.



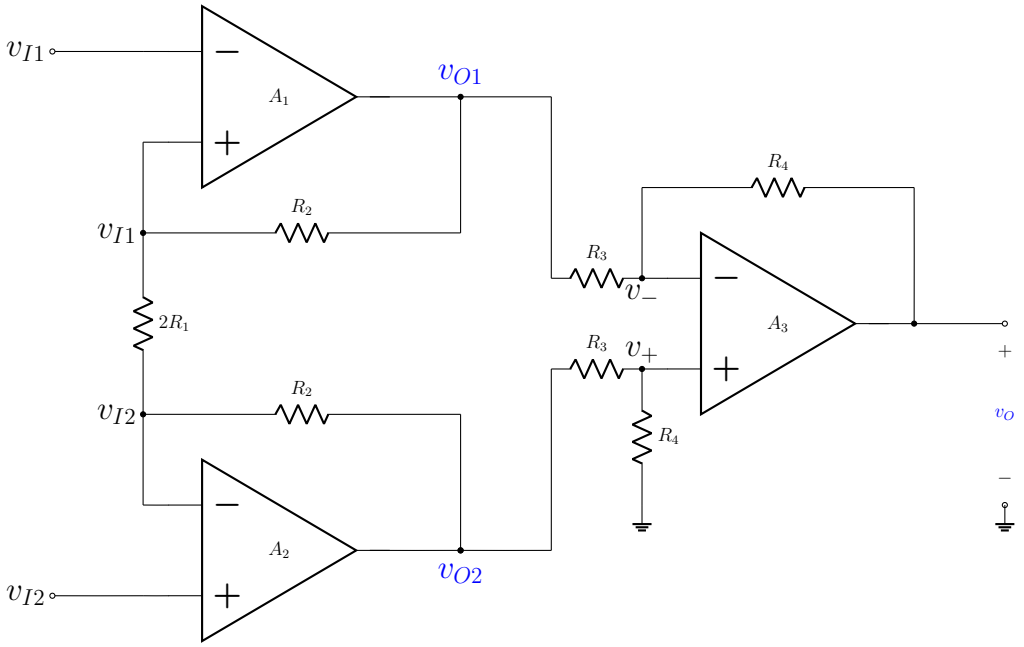
Question 2. Input and Output Resistance

Assuming the op amp to be ideal, derive an expression for the closed-loop gain v_O/v_I of the circuit shown below.



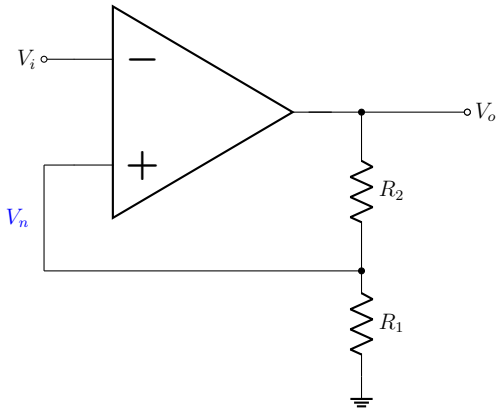
Question 3. Instrumentation Amplifier

Consider the instrumentation amplifier shown below with a common-mode input voltage of $+5V$ (dc) and a differential input signal of $10 - mV$-peak sine wave. Let $(2R_1) = 1k\Omega$, $R_2 = 0.5M\Omega$, and $R_3 = R_4 = 10k\Omega$. Find the voltage at every node (total 9 nodes) in the circuit. Also find the differential voltage gain A_d.



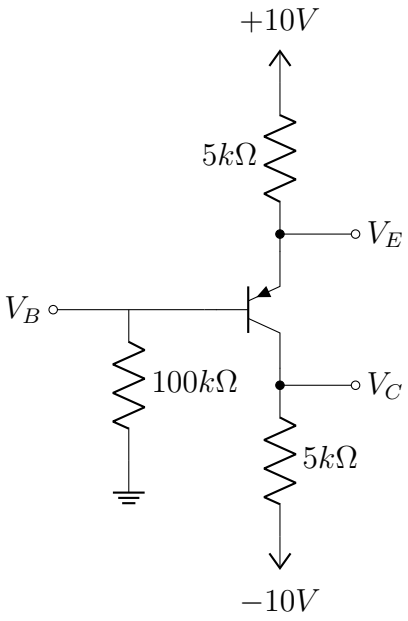
Question 4. Nonideal Amplifier Analysis

A noninverting amplifier is constructed with $R_1 = 1k\Omega$ and $R_2 = 39k\Omega$ using an operational amplifier with an open-loop gain of $80dB$ and an output resistance of 50Ω. Find the output resistance of the noninverting amplifier.



Question 5. BJT

In the circuit shown below, measurement indicates V_B to be $+1.0V$ and V_E to be $+1.7V$. What are α and β for this transistor? What voltage V_C do you expect at the collector?

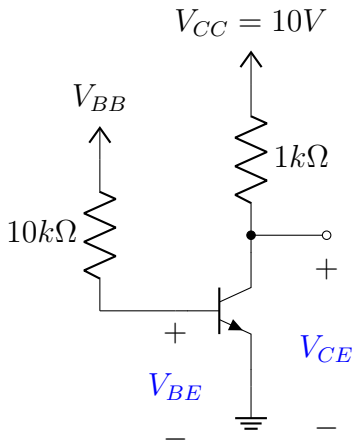


Question 6. Saturation

For the circuit shown below, it is required to determine the value of the voltage V_{BB} that results in the transistor operating

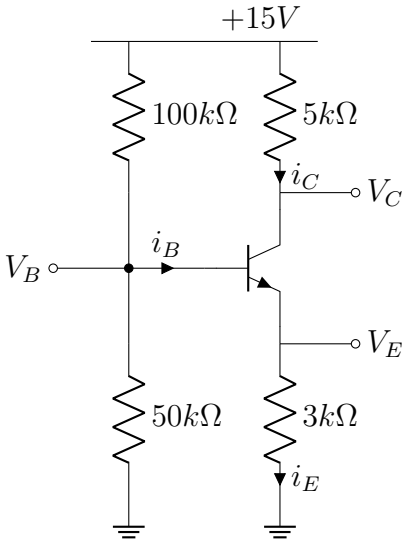
1) in the active mode with $V_{CE} = 5V$
2) at the edge of saturation
3) deep in saturation with $\beta_{forced} = 10$

For simplicity, assume that V_{BE} remains constant at 0.7 V. The transistor β is specified to be 50.



Question 7. BJT at DC

We want to analyze the circuit shown below to determine the voltages at all nodes and the currents through all branches. Assume $\beta = 100$.



Question 8. Small Signal Analysis

Consider the following BJT amplifier, determine its small-signal, open-circuit voltage gain $A_v = \frac{v_o(t)}{v_i(t)}$. Hint: Try to follow the steps to solve this question

1) Complete a D.C. Analysis.
2) Calculate the small-signal circuit parameters for each BJT.
3) Carefully replace all BJTs with their small-signal circuit model.
4) Set all D.C. sources to zero.
5) Analyze small-signal circuit.