

**ALL PRE-LAB ANSWERS MUST BE SUBMITTED THROUGH CANVAS BEFORE
NOVEMBER 15, 8:59AM**

CANDIDATES WITH NO SUBMISSION WILL NOT EARN ANY MARKS FOR LAB 4

Pre-Lab Assignment 4: Operational Amplifiers

This assignment contains two pages.

You may assume that the op amps are ideal in all cases.

Please note that **only the numerical values** to the answers for the following questions are required for submission on Canvas. **Pay attention to the units specified by each question.** There is no need to include the unit in your answer submitted on Canvas.

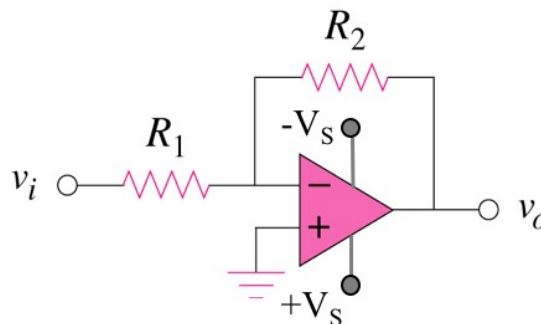


Fig 1: Circuit for questions 1 to 4

Referring to the circuit shown in Fig 1, where $V_S = 5\text{ V}$, $R_1 = 500\ \Omega$, $R_2 = 1.5\text{ k}\Omega$

1. Determine the closed-loop gain (v_o/v_i) of the circuit.
2. If $v_i = 0.3\text{ V}$, determine the voltage at the inverting input of the op amp **in V**.
3. Estimate the maximum possible value of v_o **in V**.
4. Determine the current supplied by the input source v_i **in mA**, if $v_i = 0.3\text{ V}$.

Remaining questions on the next page

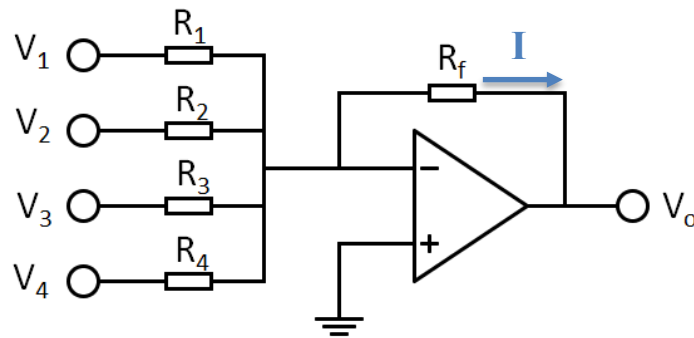


Fig 2: Circuit for questions 5 to 8

Referring to the circuit shown in Fig 2,

5. Determine the current at the non-inverting terminal **in mA**.
6. Derive the expression for V_o in terms of V_1 , V_2 , V_3 , V_4 , R_1 , R_2 , R_3 , R_4 and R_F .
7. Determine the current I through the resistor R_f .
8. We can use the summing amplifier in Fig 2 to implement a 4-bit digital-to-analogue converter (DAC). Input V_1 is called the most significant bit (MSB), while input V_4 is the least significant bit (LSB). Each lesser bit has half the weight of the next higher. Referring to the expression for V_o , what is the required relationship between R_1 , R_2 , R_3 and R_4 to realize a DAC? [Preparation note: you will need this relationship to choose the values of \$R_1\$, \$R_2\$, \$R_3\$ and \$R_4\$ in Lab 3.](#)