

EE 105 Fall 2025

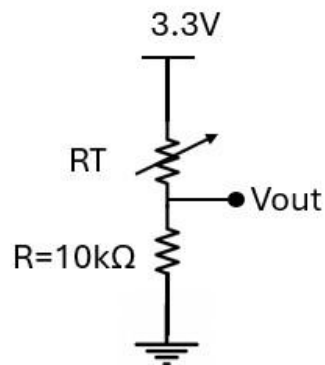
Homework 4 – upload to grade scope

(Due November 6, before class, late submission will incur 20% points/day penalty)

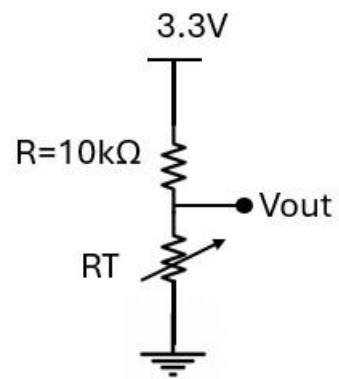
Instructions: Perform the following tasks based on the circuits and concepts discussed in class. Be sure to show all work where applicable.

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1. What is the purpose of ADC and DAC in sensor systems?

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2. During class we used the following configuration for measuring the skin temperature.

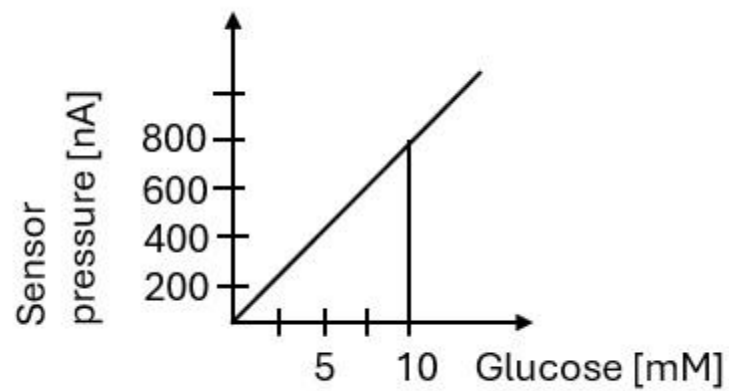


If you change the circuit to:



- i) Write an expression for $R_T = f(V_{out})$
- ii) Show the V_{out} plot when you touch the temperature sensor. Explain why V_{out} is increasing or decreasing? (use your demo board, similar to the lab)

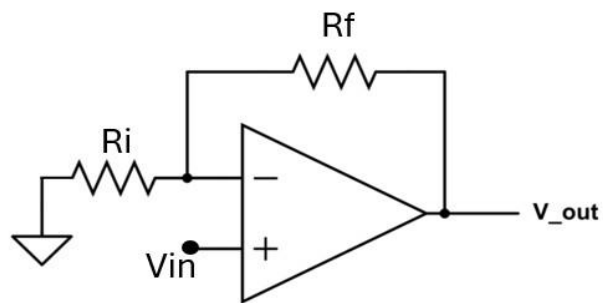
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3. Calculate the sensitivity of the glucose sensor. (Hint: sensitivity = change in output / change in input)



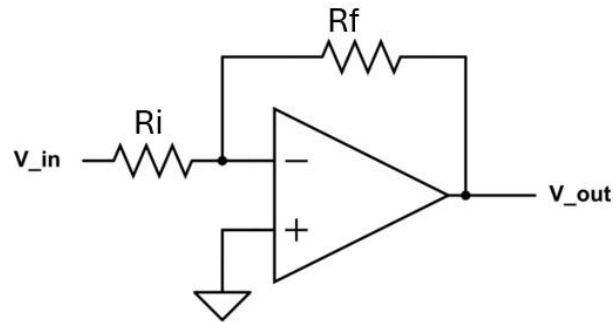
4. What is an op amp. Draw an op amp and label each terminal.

5. What are the golden rules of an op amp.

6. Derive $V_{out} = f(V_{in})$.



7. Derive $V_{out} = f(V_{in})$.



8. What is AFE analog front end?

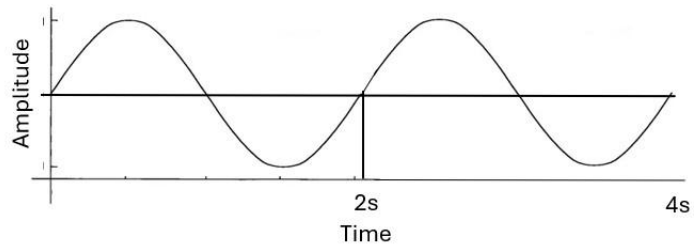
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9. Draw the system block diagram of a sensing system. What are the five steps and explain why they are needed.
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10. Why do we need two different lights in an oximeter?

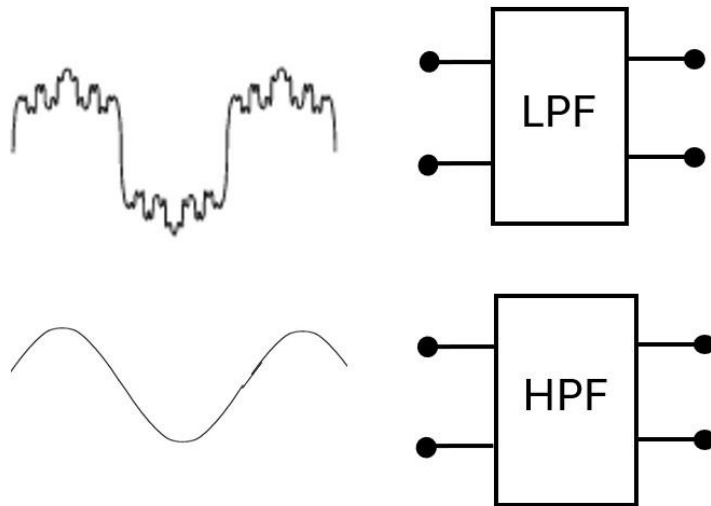
11. Write Beer Lambert's law and explain each term.

12. What are the ac and dc part of an PPG signal. If $R_{ac}=20\text{mV}$ and $R_{dc}=625\text{mV}$, $NI R_{ac}=20\text{mV}$, $NI R_{dc}=330\text{mV}$. Calculate SpO_2 .

13. Draw the Fourier component of the signals.



14. Draw the output signals.



15. In what condition oximeter reading will be 0% and 100%.