SEMINAR 5

Contents:

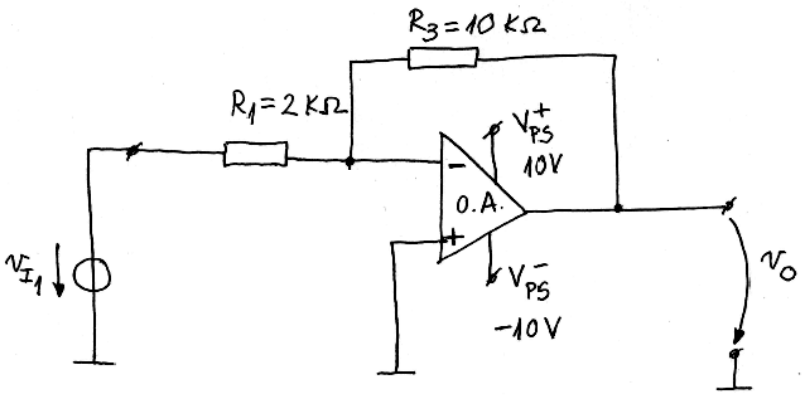
- OA Voltage Amplifiers

1. OA – ideal

a) Find the expression $v_O(v_{I1})$ assuming the range of v_{I1} small enough to keep OA in the active region. What is the application of the circuit?

b) Plot $v_O(t)$ for $v_{I1}(t)=3\sin\omega_0 t$ [V]

c) What are the values of : the input resistance R_{i1} seen by v_{I1} and the output resistance R_o of the amplifier?



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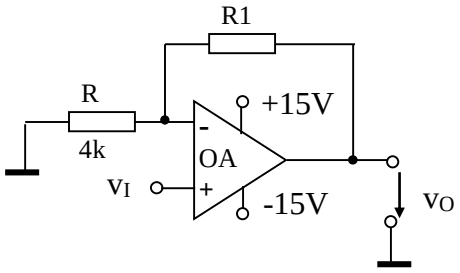
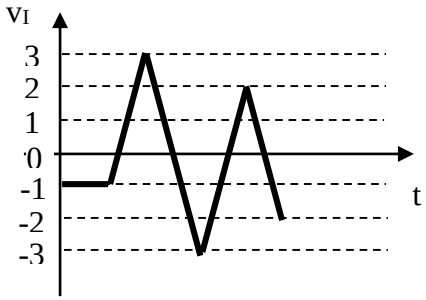


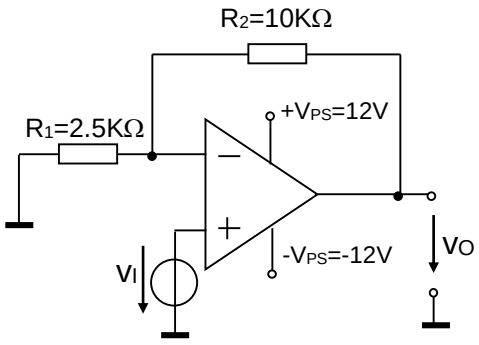


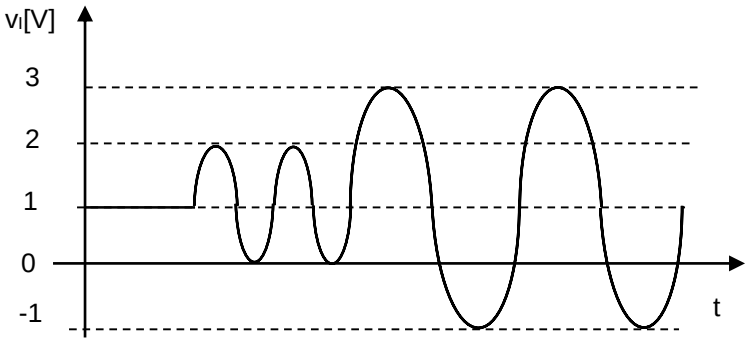
a) For R_1=12K find the values of the voltage gain, the input resistance and plot VTC $v_O(v_I)$.

b) How does the $v_O(t)$ look like for $v_I(t)$ in the above figure?

c) Redesign the circuit to obtain the adjustable voltage gain $A_v \in [5;10]$.

3.





Assume a rail-to-rail op amp.

a) What is the expression and the value of the gain and how does the VTC, $v_O(v_I)$ look like considering $v_I \in [-5V;5V]$? What is the v_I range for that the amplifier remains in its active region?

b) What are the values of the input and output resistances. What is the application of the circuit?

c) How does the $v_O(t)$ look like for $v_I(t)$ in the above figure?

d) Where another source v_{I1} should be connected to obtain $v_O=5v_I-4v_{I1}$?

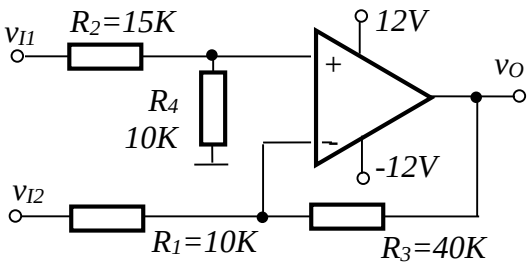
4. Assume OA – ideal.

a) Prove that the above circuit has negative feedback.

b) Assuming suitable values for v_{I1} , v_{I2} to have always the O.A. in the active region, what is the expression of $v_O(v_{I1}$, $v_{I2})$? What is the application of the circuit? Plot $v_O(t)$ for $v_{I1}(t)= 3 \sin \omega t$ [V] and $v_{I2}(t)= -v_{I1}(t)$.

c) What should be the relationship between R_1, R_2, R_3, R_4 to obtain the following expression: $v_O =5(v_{I1} - v_{I2})$?

d) For R_1, R_2, R_3, R_4 in the original schematic, compute the input resistance seen by v_{I1}.

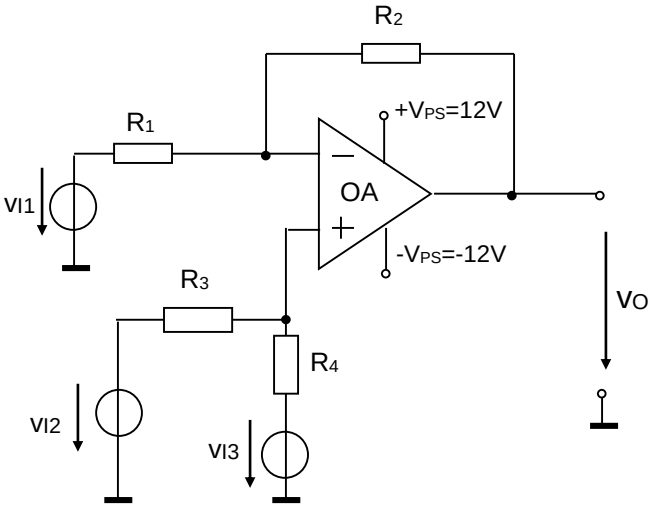


5. Assume OA – ideal

a) What is the expression of $v_O(v_{I1},v_{I2}, v_{I3})$ assuming OA in the active region for $R_1=R_2=R_3=R_4=15K\Omega$?

b) Now consider $v_{I3}=0$. Find the relationship between R_1, R_2, R_3, R_4 in order to obtain the expression : $v_O=3(v_{I2}-v_{I1})$? For what range of values of $(v_{I2}-v_{I1})$ does OA work in the active region? Deduce the expresions for input resistances considering the input only v_{I1} (with v_{I2} set to zero), respectively only v_{I2} (with v_{I1} set to zero), and the output resistance of the circuit.

c) If $v_{I3}=0$ and $v_O=3(v_{I2}-v_{I1})$ plot $v_O(t)$ assuming $v_{I1}(t)=2\sin\omega_0 t$[V]+1V si $v_{I2}(t)=-3\sin\omega_0 t$[V] +4V. What is the application of the circuit?



6. OA – ideal

a) Find the expression $v_O(v_{I1}, v_{I2})$ assuming the ranges of v_{I1}, v_{I2} small enough to keep OA in the active region. What is the application of the circuit?

b) Plot $v_O(t)$ for $v_{I1}(t) = 3\sin\omega_0 t$ [V] and $v_{I2}(t) = 3V-2\sin\omega_0 t$ [V].

c) What are the values of : the input resistance R_{i1} seen by v_{I1}; the input resistance R_{i2} seen by v_{I2}; the output resistance R_o of the amplifier?

d) What should be the relationship between R_1, R_2 and R_3 to obtain the function: $v_O=-(v_{I1}+v_{I2})$?