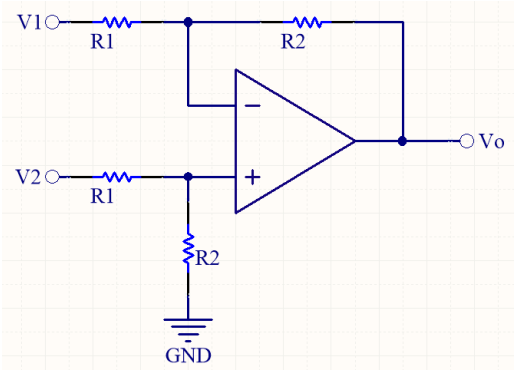
Hardverski interfejs

Vežbe 10

Napomena: Sve što je označeno plavom bojom na crtežima u sklopu zadataka je deo postavke zadataka, a sve što je označeno crvenom bojom dodato je u postupku rešavanja zadataka.

Operacioni pojačavači – nastavak

Primer 1: Za kolo sa slike naći zavisnost izlaznog napona u funkciji V_1 i V_2.

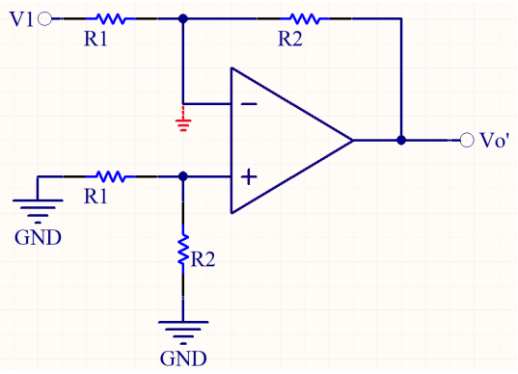


Da bi se pronašlo naponsko pojačanje neophodno je svesti ga na osnovna kola (invertujući i neinvertujući) metodom superpozicije.

1) $V_1 \neq 0;\ V_2 = 0 \Rightarrow V_o'$
2) $V_2 \neq 0;\ V_1 = 0 \Rightarrow V_o''$

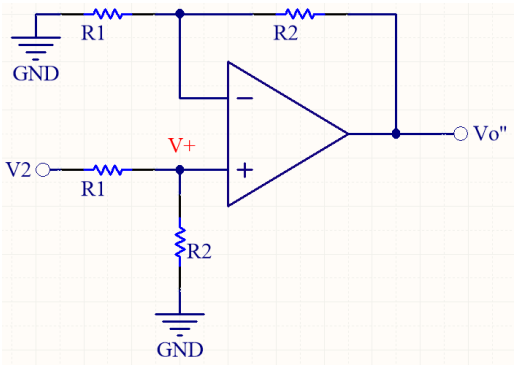
$$V_o = V_o' + V_o''$$

1) $V_1 \neq 0;\ V_2 = 0$



$$V_o' = -\frac{R_2}{R_1} \cdot V_1$$

2) $V_2 \neq 0;\ V_1 = 0$



$$V_o'' = \left(1 + \frac{R_2}{R_1}\right) \cdot V^+$$

$$V^+ = \frac{R_2}{R_1 + R_2} \cdot V_2$$

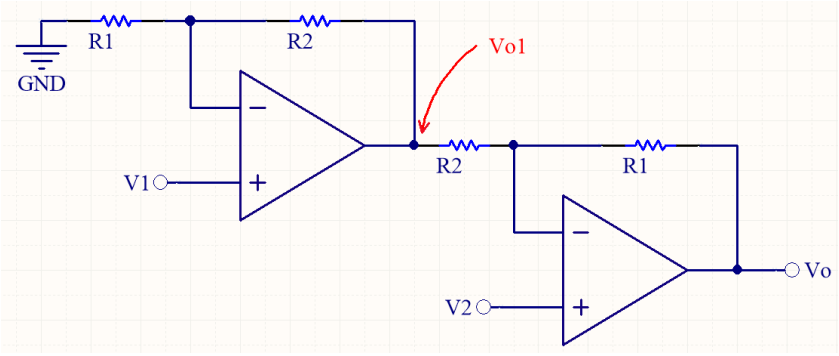
$$V_o'' = \frac{R_1 + R_2}{R_1} \cdot \frac{R_2}{R_1 + R_2} \cdot V_2 = \frac{R_2}{R_1} \cdot V_2$$

$$V_o = V_o' + V_o'' = \frac{R_2}{R_1} \cdot (V_2 - V_1)$$

$$A_v = \frac{V_o}{V_2 - V_1} = \frac{R_2}{R_1}$$

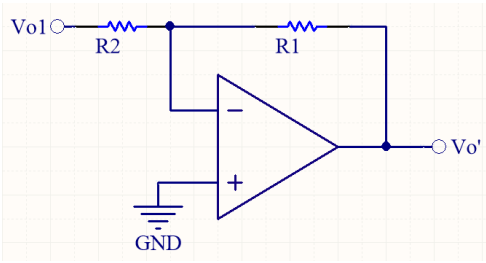
Reč je o **diferencijalnom pojačavaču** jer pojačava razliku ulaznih napona.

Primer 2: Naći zavisnost izlaznog napona u funkciji ulaznih.



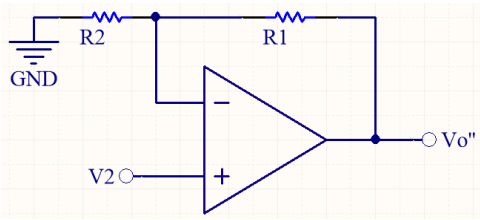
$$V_{o1} = \left(1 + \frac{R_2}{R_1}\right) \cdot V_1$$

1) $V_{o1} \neq 0;\ V_2 = 0$



$$V_o' = -\frac{R_1}{R_2} \cdot V_{o1}$$

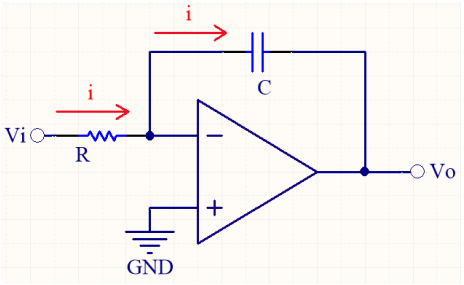
2) $V_2 \neq 0;\ V_{o1} = 0$



$$V_o'' = \left(1 + \frac{R_1}{R_2}\right) \cdot V_2$$

$$V_o = V_o' + V_o'' = -\frac{R_1}{R_2} \cdot \left(1 + \frac{R_2}{R_1}\right) \cdot V_1 + \left(1 + \frac{R_1}{R_2}\right) \cdot V_2$$

Primer 3: Naći prenosnu funkciju kola sa operacionim pojačavačem (integratora) i izlazni napon u funkciji ulaznog.



$$A(\omega) = \frac{V_o(\omega)}{V_i(\omega)} = -\frac{z_C}{z_R} = \frac{-\frac{1}{j\omega C}}{R} = \frac{-1}{j\omega CR}$$

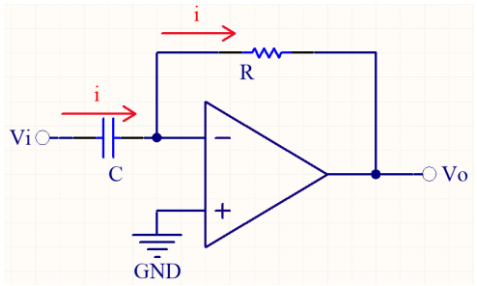
$$i = \frac{V_i}{R}$$

$$i = C \cdot \frac{d(-V_o)}{dt} = -\frac{dV_o}{dt} \cdot C$$

$$\frac{V_i}{R} = -\frac{dV_o}{dt} \cdot C$$

$$V_o = \frac{-1}{RC} \int V_i dt$$

Primer 4: Naći prenosnu funkciju kola sa slike (diferencijatora) i izlazni napon u funkciji ulaznog.



$$A(\omega) = \frac{V_o(\omega)}{V_i(\omega)} = -\frac{z_R}{z_C} = \frac{-R}{\frac{1}{j\omega C}} = -j\omega RC$$

$$i = \frac{-V_o}{R}$$

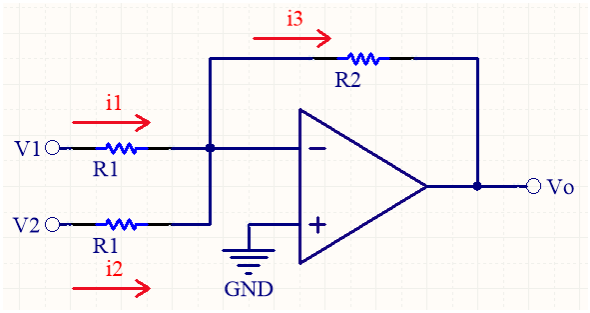
$$i = C \cdot \frac{dV_i}{dt}$$

$$\frac{-V_o}{R} = C \cdot \frac{dV_i}{dt}$$

$$V_o = -RC \cdot \frac{dV_i}{dt}$$

Primer 5. Sabirač

Naći zavisnost izlaznog napona u funkciji V_1 i V_2.



$$i_3 = i_1 + i_2$$

$$i_1 = \frac{V_1}{R_1}$$

$$i_2 = \frac{V_2}{R_1}$$

$$i_3 = -\frac{V_o}{R_2}$$

$$-\frac{V_o}{R_2} = \frac{V_1}{R_1} + \frac{V_2}{R_1} = \frac{V_1 + V_2}{R_1}$$

$$V_o = -\frac{R_2}{R_1} \cdot (V_1 + V_2)$$