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U19CS012

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DELD - FINAL PRACTICAL EXAM

(A) Problem Statement : Design a circuit using opamp to produce $V_o = 2 \times V_1 + 3 \times V_2 + V_3$

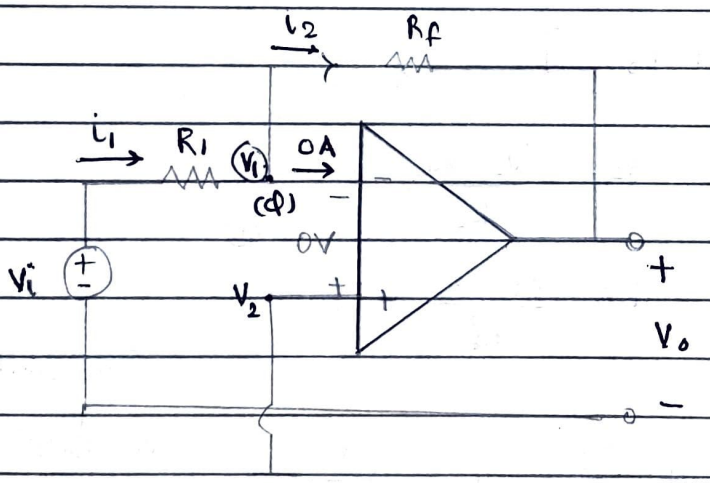
V_1, V_2, V_3 = three positive input voltages

V_o = Output voltage

[In Simulation use V1 = 1 Volt, V2 = 2 Volt, V3 = 1 Volt

(B) Theory / Concept Used :

(I) Inverting Amplifier



$\because i_1 = i_2$ (KCL at Point Φ)

$$\frac{V_i - V_1}{R_1} = \frac{V_1 - V_o}{R_f}$$

$$\left[V_o = \left(-\frac{R_f}{R_1} \right) V_i \right]$$

($\because V_1 = 0 = V_2$)

Both terminals of opamp

(*) If $R_f = R_1$, $[V_o = (-1) V_i]$

(II)

Opamp as a Summer

Applying KCL at node a gives

$$[i = i_1 + i_2 + i_3]$$

vision

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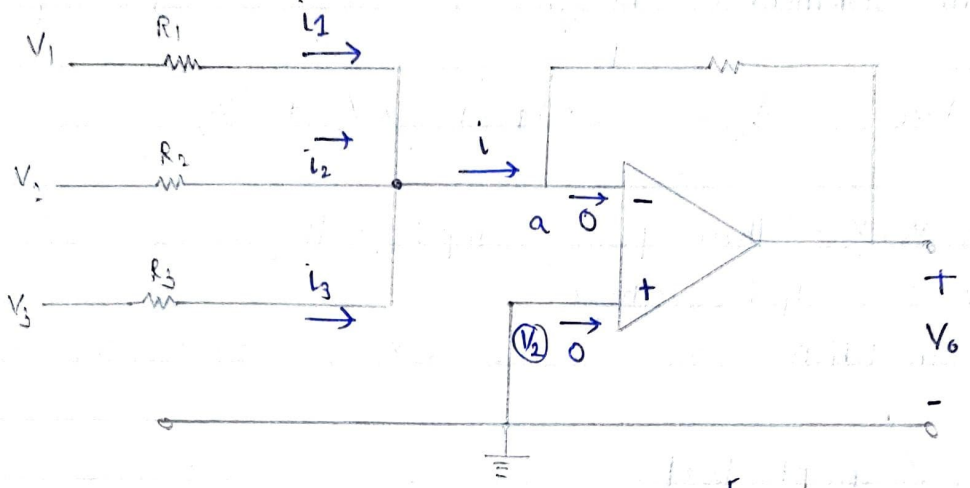

[opamp doesnot accept any current]

KCL at a,

$$[i = i_1 + i_2 + i_3]$$

$$i_1 = \frac{V_1 - V_a}{R_1}, \quad i_2 = \frac{V_2 - V_a}{R_2}$$

$$i_3 = \frac{V_3 - V_a}{R_3} \qquad i = \frac{V_a - V_o}{R_f}$$

(4)

Same potential of OPAMP Both terminals

$$\frac{V_a - V_o}{R_f} = \frac{V_1 - V_a}{R_1} + \frac{V_2 - V_a}{R_2} + \frac{V_3 - V_a}{R_3}$$

$[\because V_a = V_2 = 0]$

$$\therefore \quad -\frac{V_o}{R_f} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}$$

$$\left[V_o = \left(-\frac{R_f}{R_1}\right)V_1 + \left(-\frac{R_f}{R_2}\right)V_2 + \left(-\frac{R_f}{R_3}\right)V_3\right]$$

comparing it with question $\Rightarrow\Rightarrow$ $V_o = 2V_1 + 3V_2 + V_3$

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Idea → $V_1 \rightarrow -V_1$

$V_2 \rightarrow -V_2$

$V_3 \rightarrow -V_3$

- $\frac{R_f}{R_1} = 2$ $\quad$ $\frac{R_f}{R_2} = 3$ $\quad$ $\frac{R_f}{R_3} = 1$

$R_1 = \frac{R_f}{2}$ $\quad$ $R_2 = \frac{R_f}{3}$ $\quad$ $R_3 = R_f$

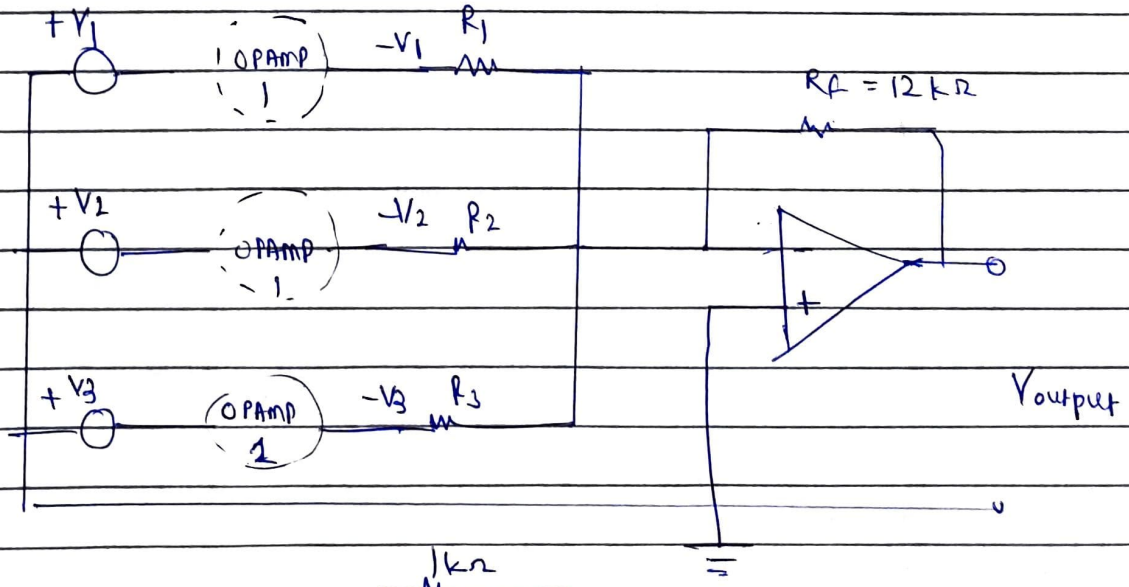
let $R_f = 12\,k\Omega$ $\quad$ $R_1 = 6\,k\Omega$

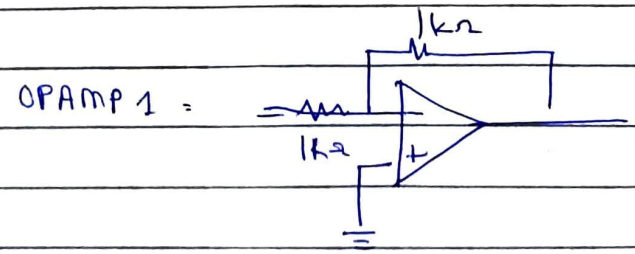
$R_2 = 4\,k\Omega$

$R_3 = 12\,k\Omega$

$V_0 = 2(1) + 3(2) + (1)$

$= 2 + 6 + 1 = [9\ Volt]$





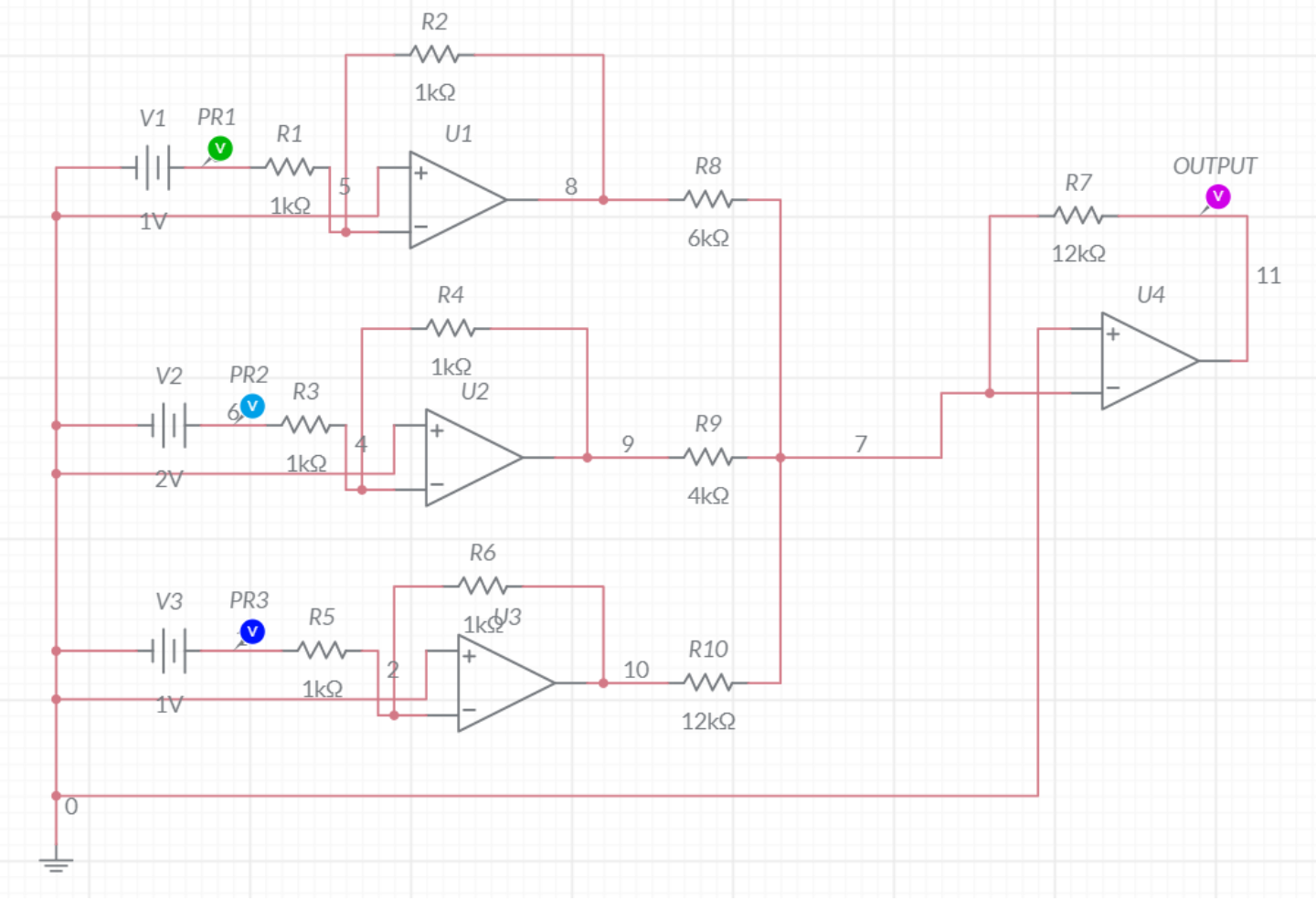
Design a circuit using OPAMPs to produce

Vo=2*V1 +3*V2+V3,

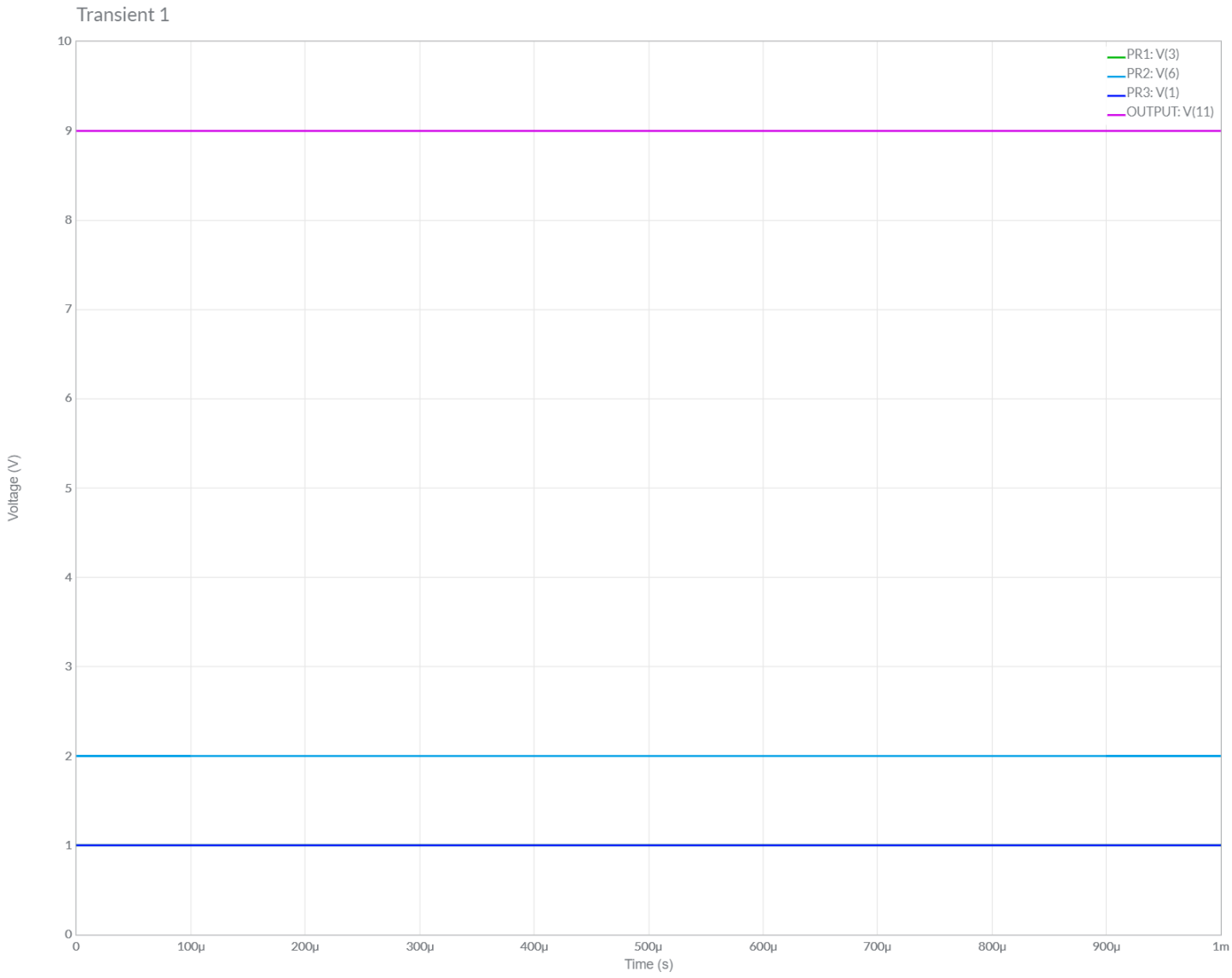
where V1 and V2 and V3 are three positive input voltages and Vo is the output. Simulate your design for *V1=1, V2=2, and V3=1*.

SIMULATION SCREENSHOTS

Circuit Diagram of OPAMP

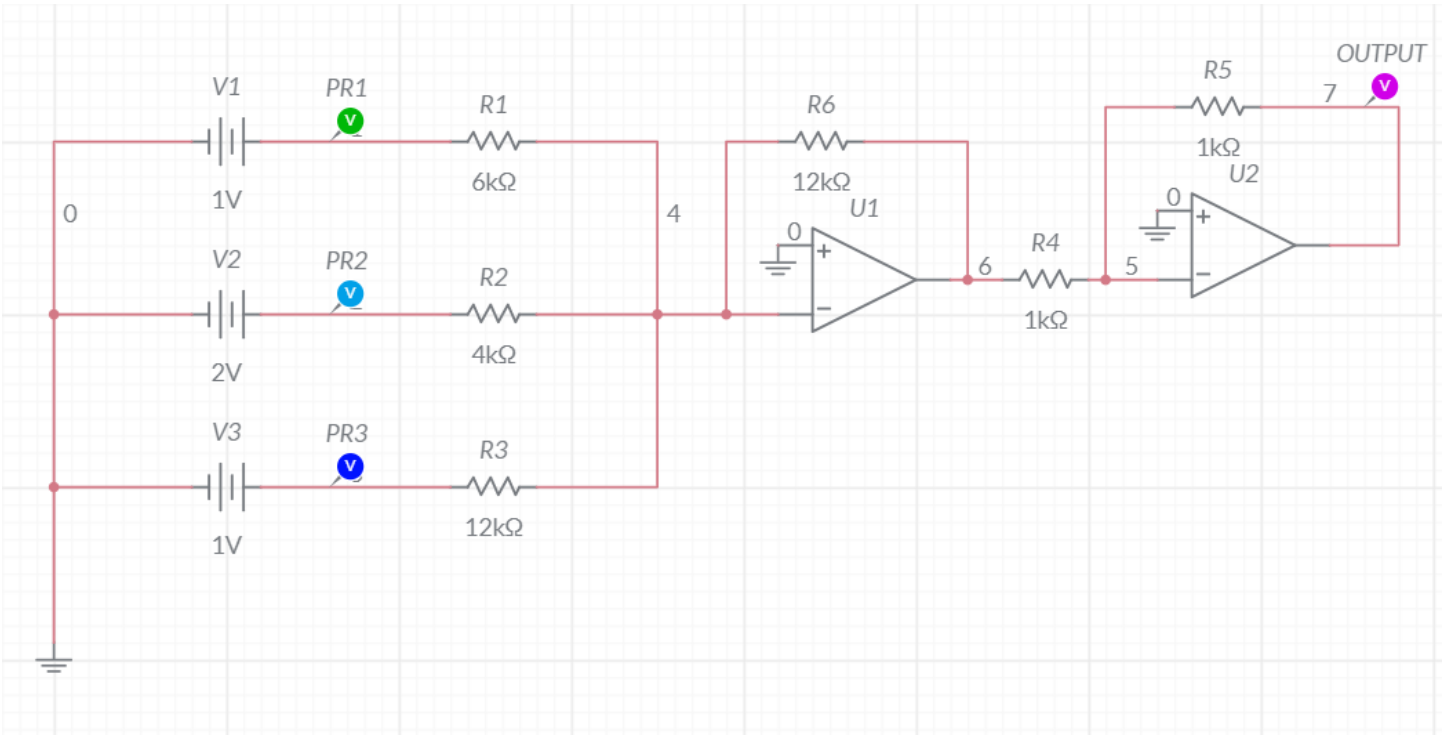


Grapher Image



SIMULATION SCREENSHOTS

Circuit Diagram of OPAMP [Optimized]



Grapher Image [OPAMP Optimized Approach]