July 08) Design an adder circuit using an op-amp to get the output expression as $V_o = -[0.1V_1 + V_2 + 10V_3]$ where V_1, V_2 and V_3 are the inputs.

For inverting summing amplifier

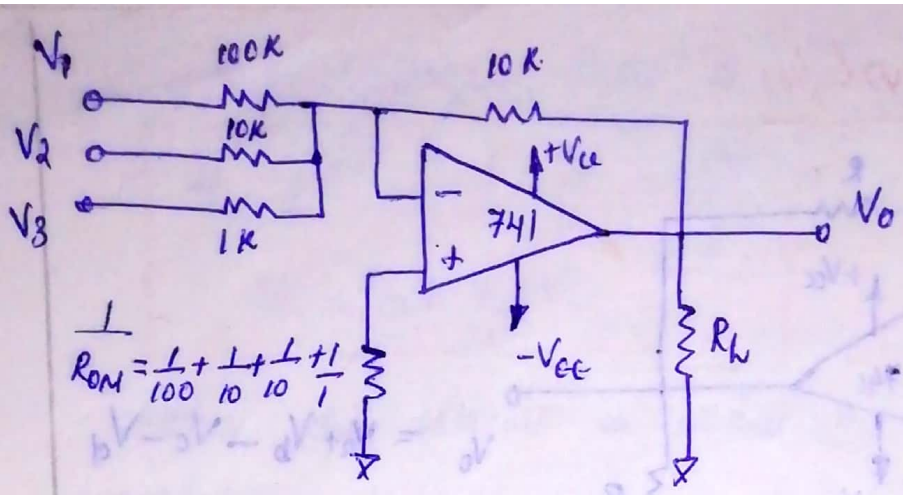
$$V_o = -\left[\frac{R_F}{R_a}V_a + \frac{R_F}{R_b}V_b + \frac{R_F}{R_c}V_c\right]$$

Let $R_F = 10K\Omega$

$$\frac{R_F}{R_a} = 0.1, \quad R_a = \frac{10K}{0.1} = 100K\Omega$$

$$\frac{R_F}{R_b} = 1; \quad R_b = 10K\Omega$$

$$R_F/R_c = 10; \quad R_c = \frac{10K}{10} = 1K\Omega$$



$$\frac{1}{R_{OM}} = \frac{1}{100} + \frac{1}{10} + \frac{1}{10} + \frac{1}{1}$$

(2) Design and draw an op-amp ckt to get $V_o = 3V_1 - 2V_2 - 4V_3$, where V_1, V_2 & V_3 are input voltages.

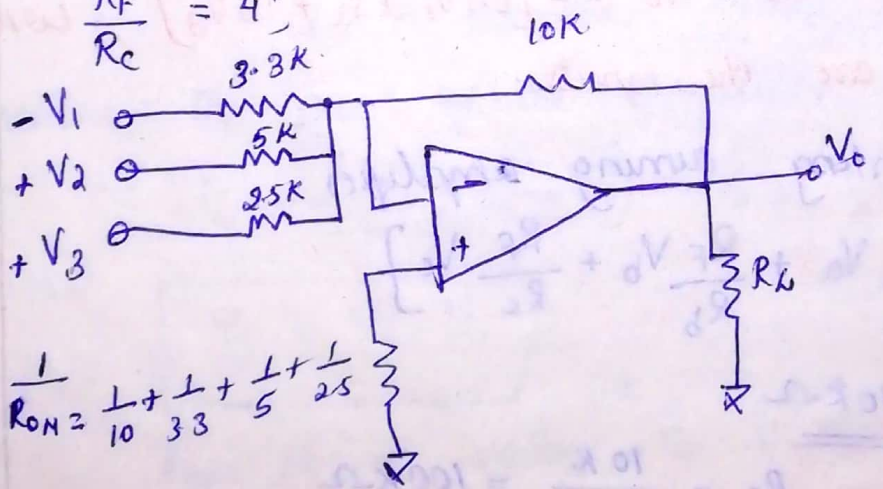
$$V_o = 3V_1 - 2V_2 - 4V_3 = -\left[\frac{R_F}{R_a}V_1 + \frac{R_F}{R_b}V_2 + \frac{R_F}{R_c}V_3\right]$$

Let $R_F = 10K\Omega$

$$\frac{R_F}{R_a} = 3; \quad R_a = \frac{10K}{3} = 3.3K\Omega$$

$$\frac{R_F}{R_b} = 2; \quad R_b = \frac{10K}{2} = 5K\Omega$$

$$\frac{R_F}{R_c} = 4; \quad R_c = \frac{10K}{4} = 2.5K\Omega$$



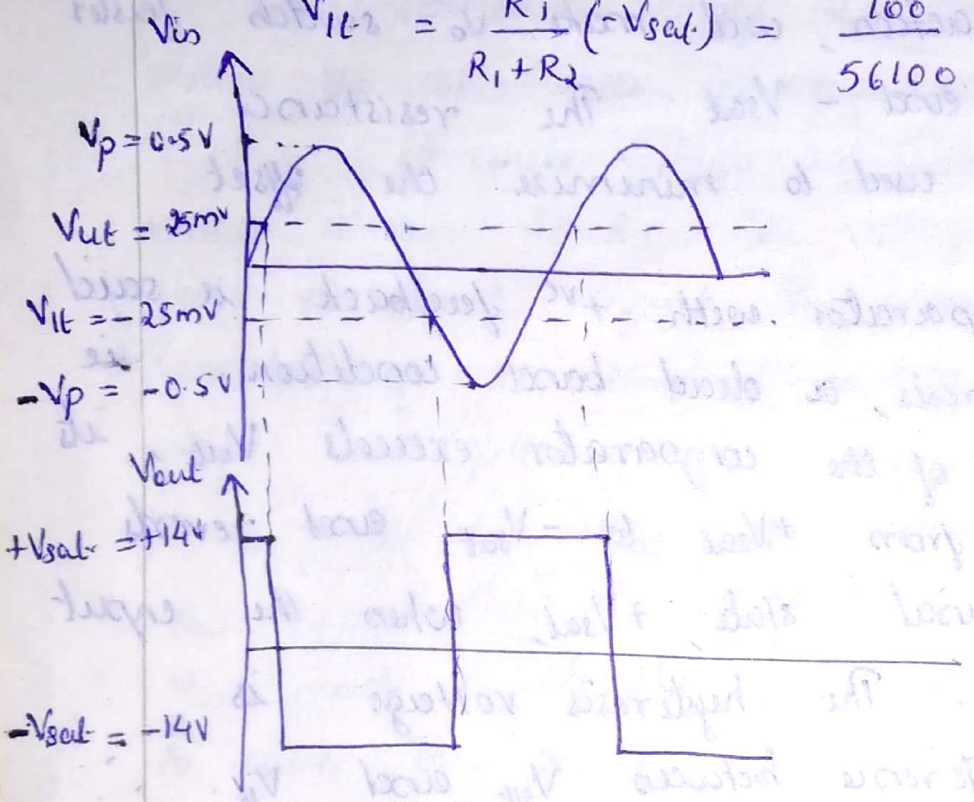
$$\frac{1}{R_{OM}} = \frac{1}{10} + \frac{1}{3.3} + \frac{1}{5} + \frac{1}{2.5}$$

(2). In the circuit of schmitt trigger $R_1 = 100\,\Omega$, $R_2 = 56\,K\Omega$, $V_{in} = 1\,V_{pp}$ sine wave, used the op-amp is type 741 with supply voltages $\pm 15\,V$. Determine the threshold voltages V_{ut} and V_{lt} and draw the output waveform.

Ans: For 741 the max o/p voltage swing is ±14 V, ie $+V_{sat} = 14\,V$ and $-V_{sat} = -14\,V$.

$$V_{ut} = \frac{R_1}{R_1+R_2}(+V_{sat}) = \frac{100}{56100} \times 14 = 25\,mV$$

$$V_{lt} = \frac{R_1}{R_1+R_2}(-V_{sat}) = \frac{100}{56100}(-14) = -25\,mV$$



(a) Design an op-amp 741 schmitt trigger with UTP = +5 V, LTP = -1V. Assume that $V_{sat} = \pm 13V$ when $V_{cc} = \pm 15V$. Draw the ckt.

$$V_{ut} = \frac{R_1}{R_1+R_2}(+V_{sat})$$

$$5 = \frac{13R_1}{R_1+R_2}(V_{sat}) \qquad 5(R_1+R_2) = 13R_1$$

$$5R_2 = 8R_1 \quad \text{---} (1)$$

$$V_{lt} = \frac{R_1}{R_1+R_2}(-V_{sat})$$

$$-1V = \frac{R_1}{R_1+R_2}(-13\,V) \qquad R_1+R_2 = 13R_1$$

$$R_2 = 12R_1 \quad \text{---} (2)$$

sub (2) in (1) $5 \times 12R_1 = 8R_1$ find R_1