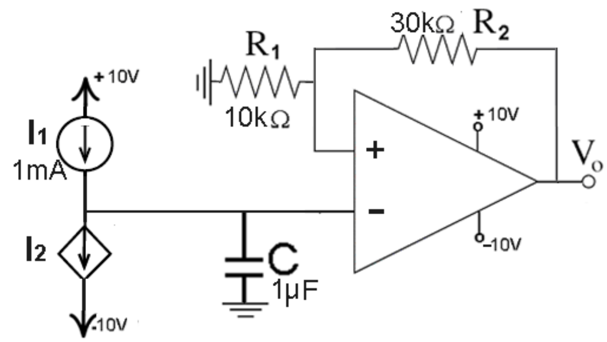
The controlled current source in the figure given as



Vo=+10V → $I_2=0$
Vo=-10V → $I_2=2xI_1=2mA$

a) Find the hysteresis limits.
b) Draw Vo(t) for the hysteresis limit values of -3V and +3V
c) Design I2
d) For the same frequency, for the pulse-space ratio of 1/3, find I1/I2 and I1.

2- a) $V_{E+} = \frac{10}{40k}\cdot 10k = 2{,}5V$

$V_{E-} = \frac{-10}{40k}\cdot 10k = -2{,}5V$

b) $V_C > 3V \rightarrow V_o = -10V$

$V_C < -3V \rightarrow V_o = +10V$

Lets take that $V_c(0)=0V$ $V_o(0)=+10V$

$V_P = V_{E+} = 3V$ olur.

C charges and when Vc=3V, the output becomes Vo=-10V
Then, C discharges and When Vc=-3V, the output becomes Vo=+10V
These cases repeat continously.

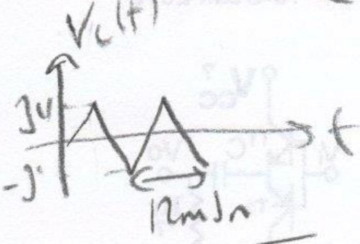
$\Delta V_C = 3-(-3V) = 6V$ olur

The current charging C; $I_1 - I_2 = 1mA - 0 = 1mA$
(When C charges, Vo=10V and I2=0)

The current discharging C; $I_1 - I_2 = 1mA - 2mA = -1mA$
(When C discharges, Vo=-10V and I2=2mA)

$$I_C = C \cdot \frac{\Delta V_C}{\Delta t} \rightarrow \Delta t_d = C \cdot \frac{\Delta V_C}{I_C}$$

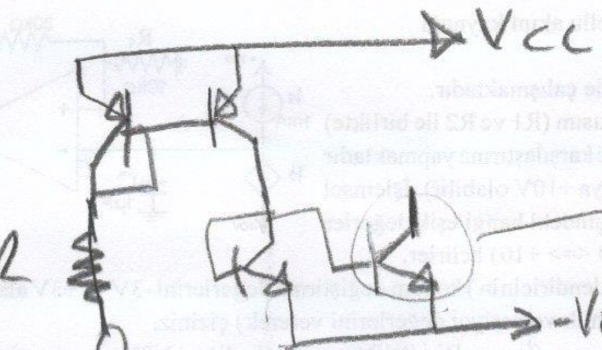
$$= 1\,mF \cdot \frac{6V}{1\,mA}$$



$$\Delta t = 6\,msn = \Delta t_b$$

$$T = \Delta t_d + \Delta t_b = 12\,msn \cong 83\,Hz$$

c)



$$R = \frac{20-0{,}7}{2mA} \quad V_o$$

$$\cong 9{,}7k\Omega$$

d) $V_o = +10V$ pulse $\quad V_o = -10V$ space $\quad \left(\frac{\text{discharging}}{\text{charging}} = \frac{1}{2}\right)$

$$\frac{I_2 - I_1}{I_1} = \frac{1}{3}$$ should be provided

$$\frac{I_2}{I_1} = \frac{4}{3}$$

$$T = 12\,msn \rightarrow t_d = 3\,msn = C\frac{\Delta V_C}{I_1}$$

$$I_1 = \frac{1mF}{3msn} \cdot 6 = 2mA$$