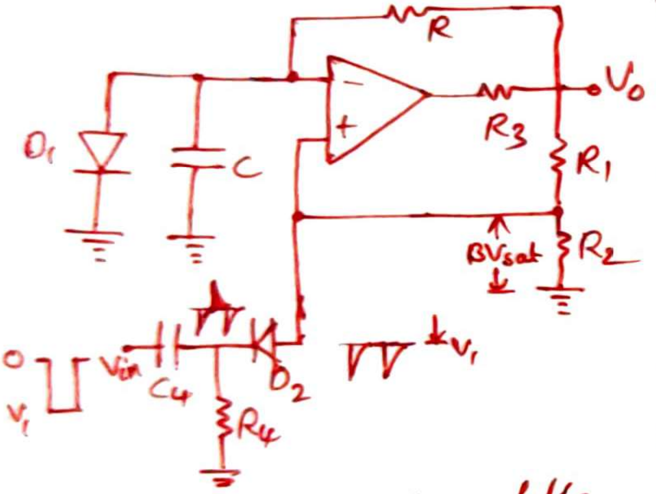
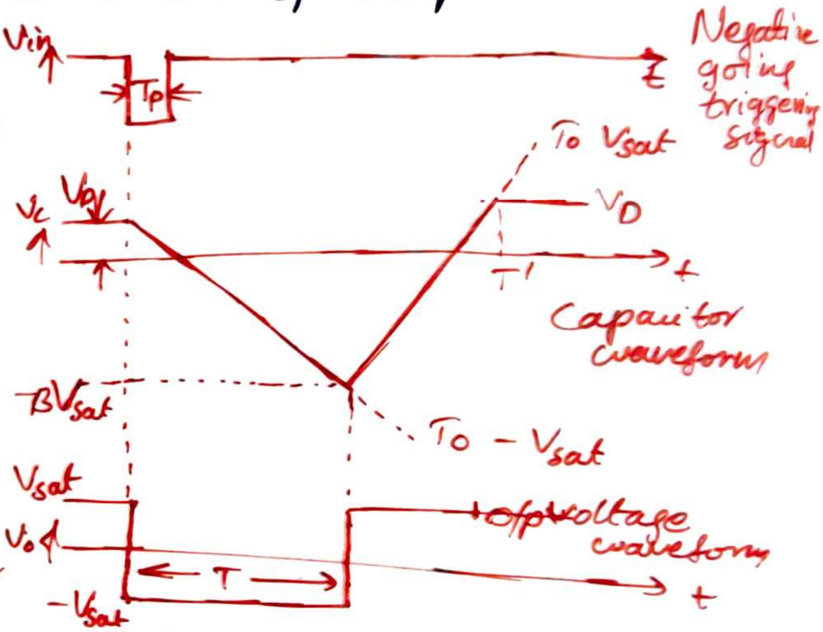
Monostable Multivibrator

- It has one stable state & the other is quasi stable state
- The ckt is useful for generating single o/p pulse of adjustable time duration in response to a triggering signal.
- The width of o/p pulse depends only on external components connected to the op-amp.



Monostable multivibrator



- Let us assume that in the stable state the o/p V_0 is at $+V_{sat}$
- The diode D_1 conducts & V_c the voltage across the capacitor C gets clamped to 0.7V.
- Now, if a negative trigger of magnitude V_1 is applied to + i/p terminal so that the effective signal at this terminal is less than 0.7V ie, $[\beta V_{sat} + (-V_1)] < 0.7\,V$
- So the o/p of the op-amp will switch from $+V_{sat}$ to $-V_{sat}$.
- Now diode get reverse biased & the capacitor starts discharging exponentially to $-V_{sat}$ through the resistance R.

- The voltage at the + i/p terminal is now $-\beta V_{sat}$
- When the capacitor voltage V_c becomes just more negative than $-\beta V_{sat}$, the o/p of the op-amp switches back to $+V_{sat}$.

$$V_c = V_f + (V_i - V_f)\, e^{-t/RC}$$

- For the ckt $V_f = -V_{sat}$ & $V_i = V_D$ (diode forward Voltage)

$$V_c = -V_{sat} + (V_D + V_{sat})\, e^{-t/RC}$$

- At $t = T$ $\quad V_c = -\beta V_{sat}$

$$\therefore \; -\beta V_{sat} = -V_{sat} + (V_D + V_{sat})\, e^{-T/RC}$$

- After simplification, pulse width T is obtained as

$$T = RC \ln\left(\frac{1 + V_D/V_{sat}}{1-\beta}\right)$$

where $\beta = R_2/R_1+R_2$

- If $V_{sat} >> V_D$ & $R_1 = R_2$ so that $\beta = 0.5$, then

$$T = 0.69RC$$

- For monostable operation, the trigger pulse width T_p should be much less than T, the pulse width of the monostable multivibrator.
- The diode D_2 is used to avoid malfunctioning by blocking the positive noise spikes that may be present at the differentiated trigger i/p.

Regenerative Comparator (Schmitt Trigger)

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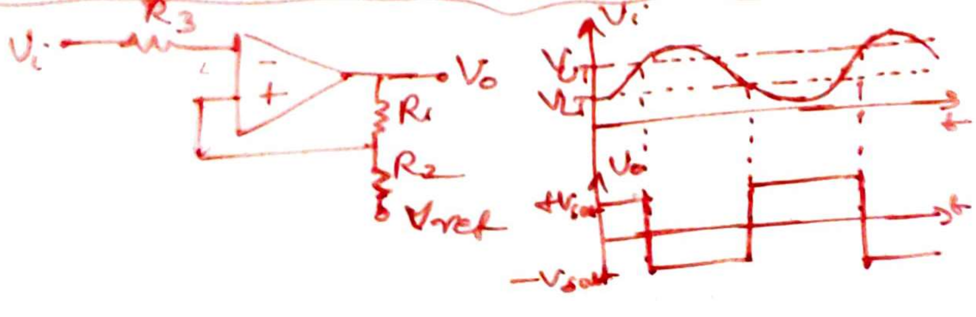
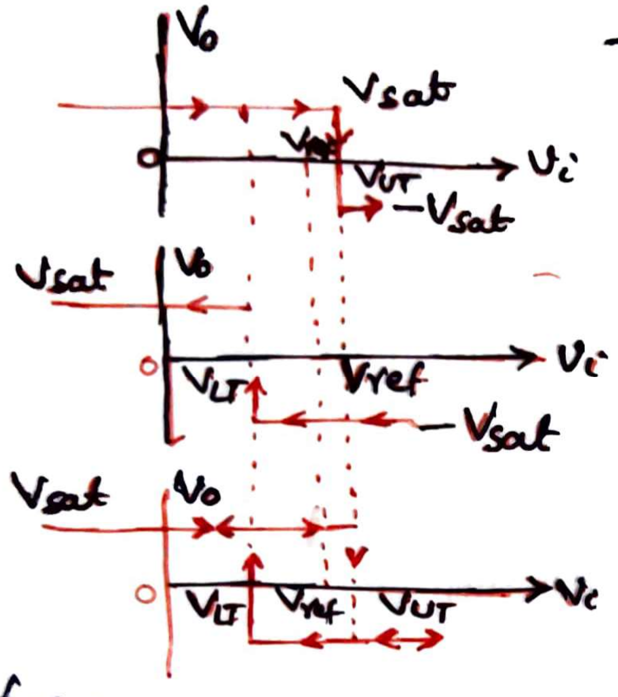


- The i/p voltage V_i triggers the o/p V_o every time it exceeds certain voltage levels.
- These voltage levels are called upper threshold voltage (V_{UT}) & lower threshold voltage (V_{LT})



- The hysterisis width is the difference between these two thresholds voltages i.e. $V_{UT} - V_{LT}$
- For $V_o = +V_{sat}$, the voltage at + i/p terminal is

$$V_{UT} = \frac{V_{ref} R_1}{R_1 + R_2} + \frac{R_2 V_{sat}}{R_1 + R_2}$$

This is called upper threshold voltage V_{UT}

- As long as V_i is less than V_{UT}, the o/p V_o remains const at $+V_{sat}$
- When V_i is just greater than V_{UT}, the o/p regeneratively switches to $-V_{sat}$ & remains at this level as long as $V_i > V_{UT}$
- For $V_o = -V_{sat}$, the voltage at + i/p terminal is

$$V_{LT} = \frac{V_{ref} R_1}{R_1 + R_2} - \frac{R_2 V_{sat}}{R_1 + R_2}$$

This voltage is called lower threshold voltage V_{LT}

- The i/p voltage V_i must become lesser than V_{LT} in order to cause V_o to switch from $-V_{sat}$ to $+V_{sat}$.
- Note that $V_{LT} < V_{UT}$
- Hysterisis width, $V_H = V_{UT} - V_{LT} = \frac{2 R_2 V_{sat}}{R_1 + R_2}$
- Because of the hysterisis, the ckt triggers at a higher voltage for increasing signals than for decreasing ones