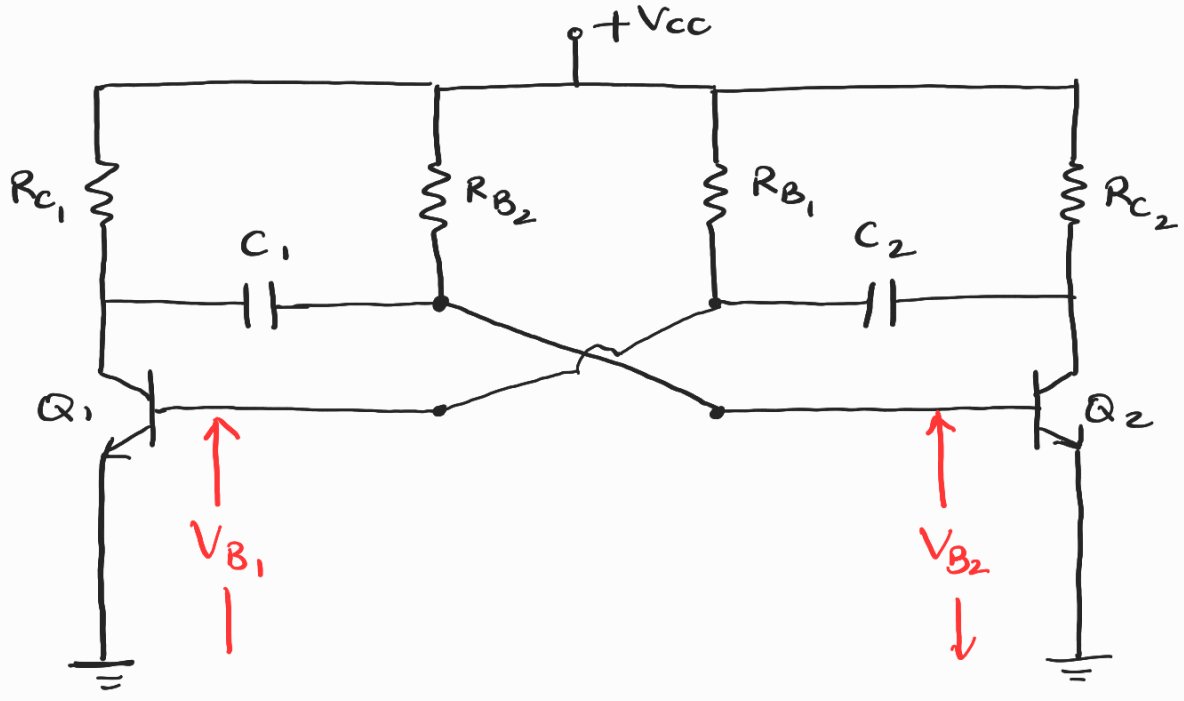
ASTABLE MULTIVIBRATOR :-

An astable multivibrator is also called as free running relaxation oscillator. It is used for producing square wave.

Circuit Description:-



1.) There are 2 identical transistor Q_1 & Q_2.

2.) Q_1 & Q_2 are cross coupled. i.e; the collector of Q_1 is connected to the base of Q_2 and similarly, collector of Q_2 is connected at the base of Q_1.

3.) The amplifying stage provides 180° phase shift and C provides 180°.
Total phase shift is 360° or 0°. Thus a positive feedback is present.

4.) $R_B > R_C$ i.e $R_{B_1} > R_{C_1}$ & $R_{B_2} > R_{C_2}$.

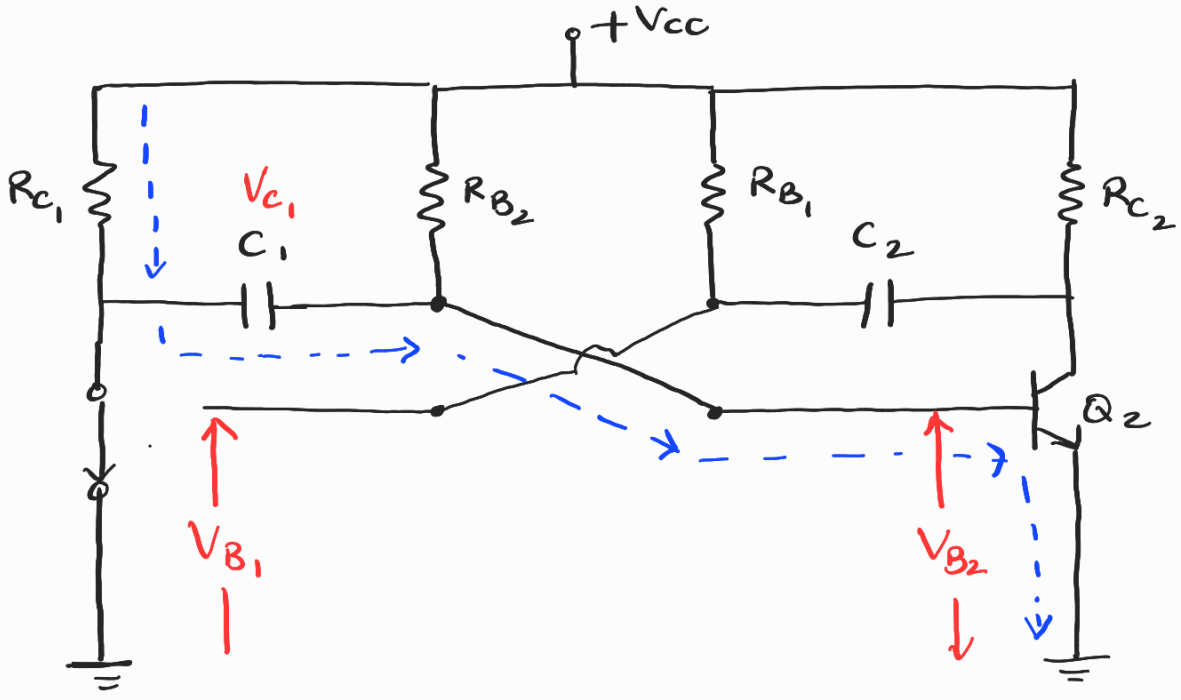
5.) Either of the transistor conducts at a time due to imbalance in the circuit.

Working :-

1.) Initially without the supply both the transistors Q_1 & Q_2 are in the 'OFF' state.

2.) When supply voltage Vcc is applied, one of the transistor will conduct.

3.) let's say Q_1 is conducting, C_1 starts charging through R_{C_1}.



4.) As Q_1 is ON it acts as a close switch or short circuit path. The transistor is in the saturation region.

5.) The output is obtained at the collector of Q_1 which is 0V. Thus capacitor now connected to the ground.

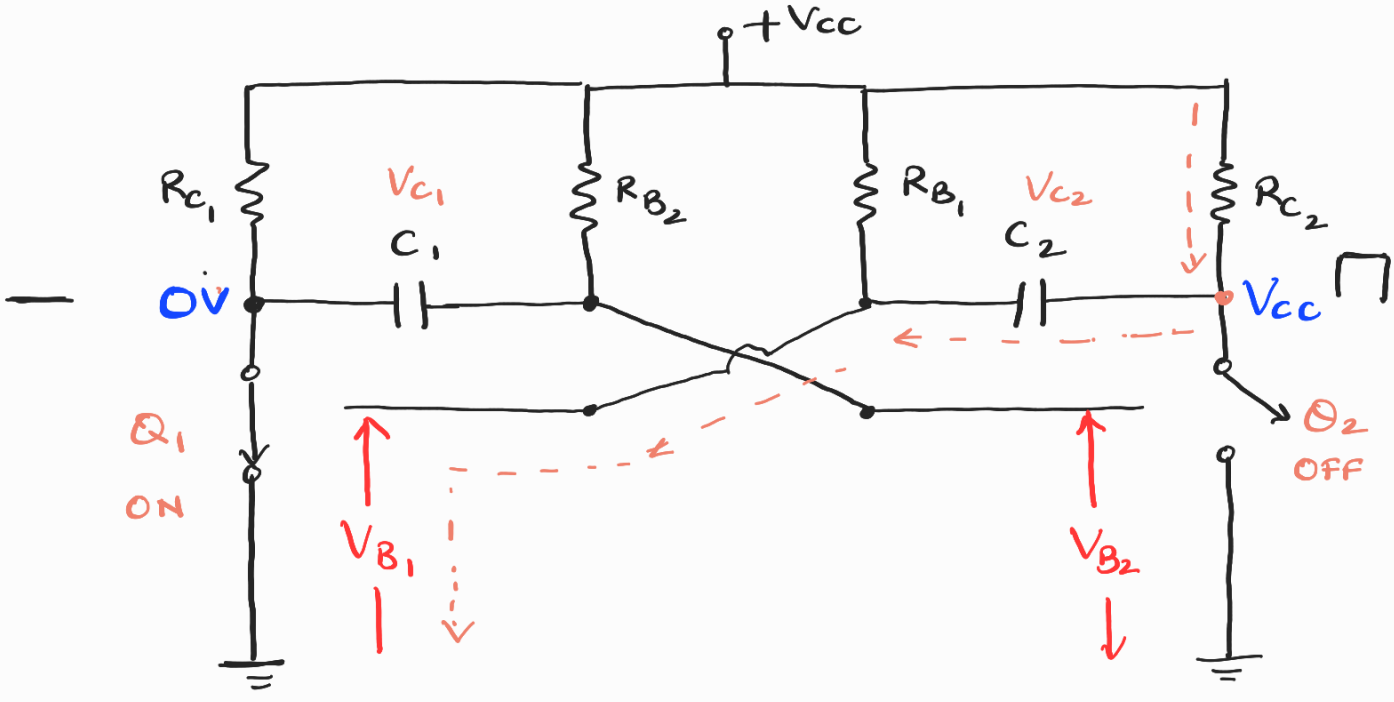
6.) Due to this the capacitor starts charging in reverse direction. i.e; the capacitor C charges through R_{B_2}. $\tau' = R_{C_1} \cdot C_1$

7.) The collector is connected to the base of the Q_2. Thus 0V volt is connected at

the base of Q_2 which turns Q_2 OFF.

8.) As Q_2 is OFF it acts as an open switch or open circuit path.

9.) The output at collector of Q_2 now is Vcc.



10.) The voltage across the capacitor C_2 is $Vcc - V_{BE}$. ($\because Vcc - V_{C_2} - V_{BE} = 0$ $\therefore V_{C_2} = Vcc - V_{BE}$).

11.) Q_1 turns 'ON' as the V_{BE} is greater than 0.7V. $T_2 = R_{B_1} C_2$.

12.) T_1 represents the duration for which the transistor Q_1 is ON and Q_2 OFF. Similarly time period T_2 represents for which the Q_2 is ON and Q_1 is OFF.

13.) Both time periods T_1 & T_2 depends upon charge of capacitors C_1 & C_2. It can be

$$T_1 = 0.69 R_{B_2} C_1$$

$$T_2 = 0.69 R_{B_1} C_2.$$

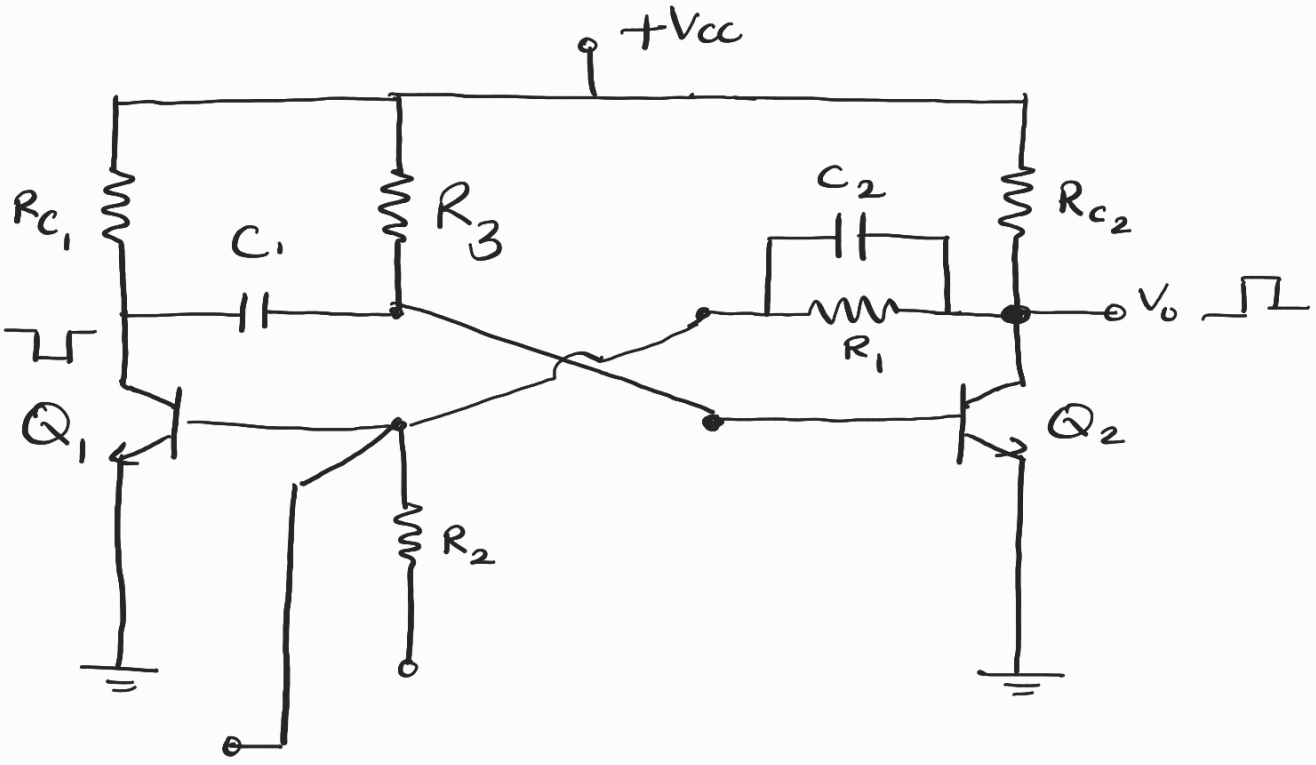
$$T = T_1 + T_2 = 0.69 (R_{B_2} C_1 + R_{B_1} C_2).$$

MONOSTABLE MULTIVIBRATOR :-

(1.) It is also called one shot or univibrator and can be used to generate a gating pulse, whose width can be controlled.

(2.) It provides single pulse of desired duration in response to an external trigger.

Circuit Description :-



(1.) It consist of 2 NPN transistors Q_1 & Q_2, both are cross coupled.

(2.) C_1 – commutating capacitor or speed up capacitor for making abrupt transitions b/w ON and OFF states.

(3.) The base of transistor Q_2 is returned to Vcc supply through resistor R_3 while

the base of Q_1 is connected to the -ve supply through a resistor R_2.

(4) The advantage of this biasing is that it keeps the transistor Q_1 off and Q_2 ON. This state is known as stable state of the monostable multivibrator.

(5) The two outputs are complement of each other.

Working :-

(1) When a 'tve' trigger pulse of sufficient amplitude is applied to the base of Q_1 it overrides the reverse bias provided by the V_{BB} supply and gives it a forward bias. Because of this Q_1 starts conducting.

(2) The o/p at Q_1 is 0V. This is coupled to the base of Q_2 which decreases the forward bias of transistor Q_2.

(3) Because of reduce forward bias Q_2 collector voltage starts increasing exponentially towards $\frac{V_{CC} \cdot R_1}{R_1 + R_{C_2}}$ with

a time constant $T_2 = C_1 \cdot (R_1 \,||\, R_{C_2})$

(4) The rising V_{C_2} of Q_2 is coupled to the base of Q_1 through R_1, where it further increase forward bias & Q_1 conducts more.

(5.) This action is cummulative because of the +ve feedback and V_{C_1} falls to $V_{CE(sat)} = 0V$.

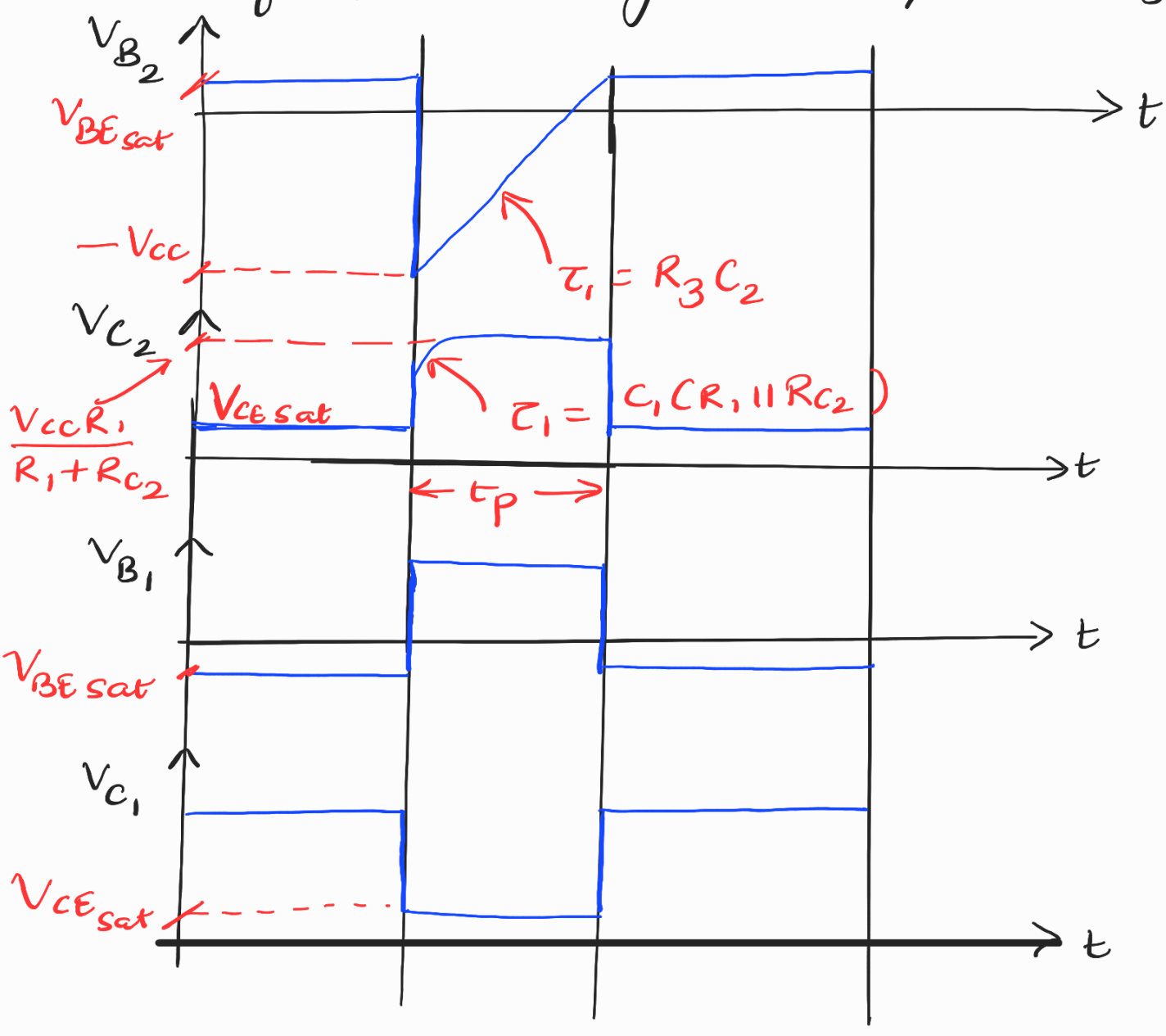
(6.) C_2 starts charging exponentially towards V_{CC} with a time constant $\tau_1 = C_2 R_3$.

(7.) C_1 charges further and Q_2 is turned ON and Q_1 OFF.

(8.) When Q_2 is ON, $V_{C_2} = V_{CE(sat)}$ & Q_1 is OFF, $V_{C_1} = V_{CC}$.

$\tau_3 = C_2 R_{C_1}$.

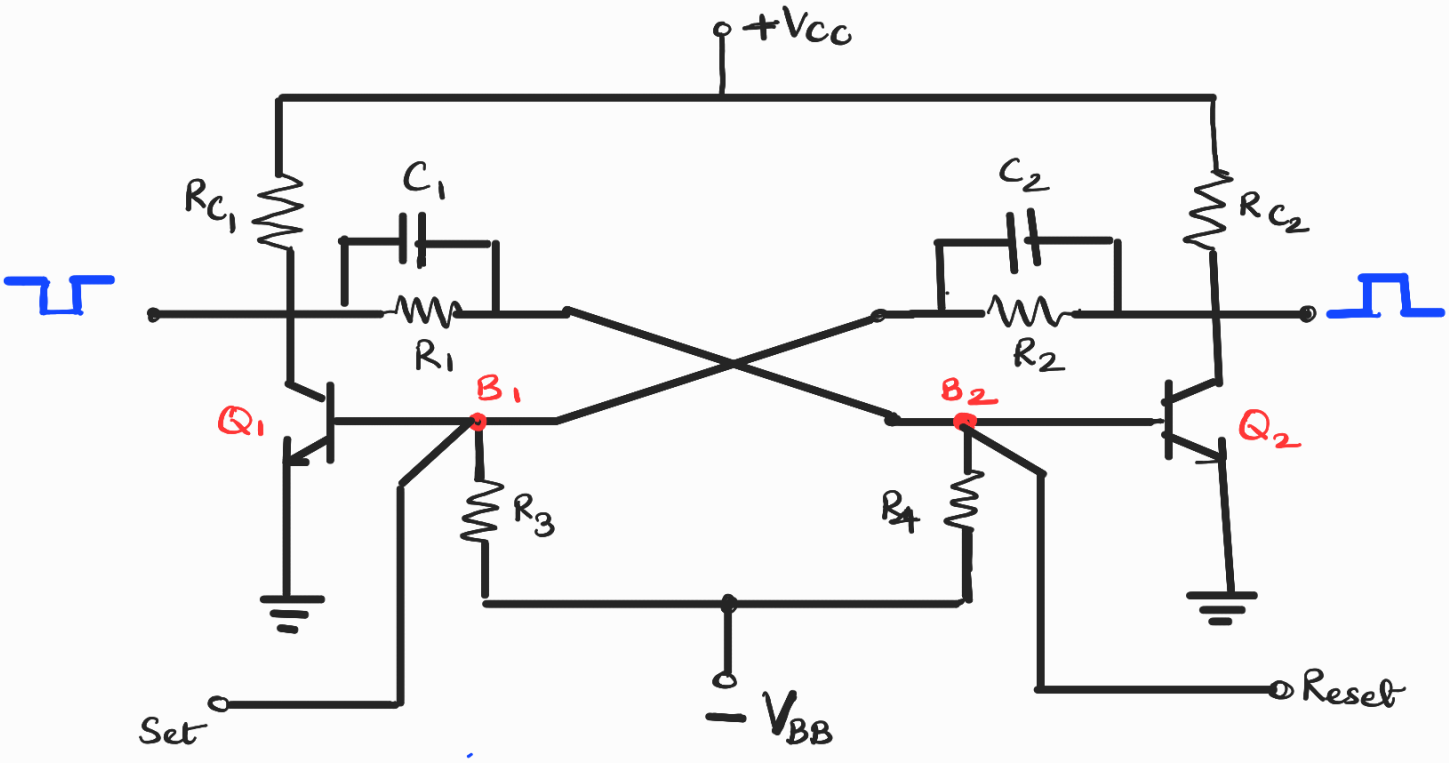
(9.) The pulse width at the collector of Q_1 & Q_2 is given as $t_p = 0.69 R_3 C_1$.



BISTABLE MULTIVIBRATOR :-

1. It is also called flip-flop.
2. It is used for counting and storing binary information in computer.
3. It has 2 stable states and can stay in any one of these 2 states, indefinitely, as long as the power is supplied.
4. It changes to the other state only when it receives a trigger (a short direction pulse) from outside.

Circuit Description :-



1) 2 NPN transistor is cross coupled.
2) C_1 & C_2 are speed up capacitors. Its function is to increase the speed of the circuit in making transition from one stable state to another stable state.
3) The base resistors are connected to $-V_{BB}$.
4) The O/P is obtained at the collector.

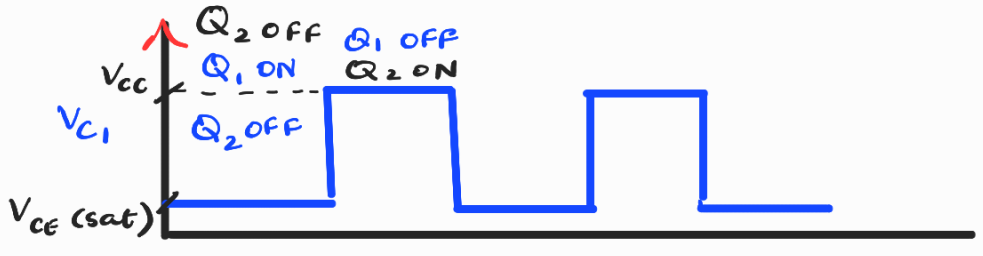
Working :-

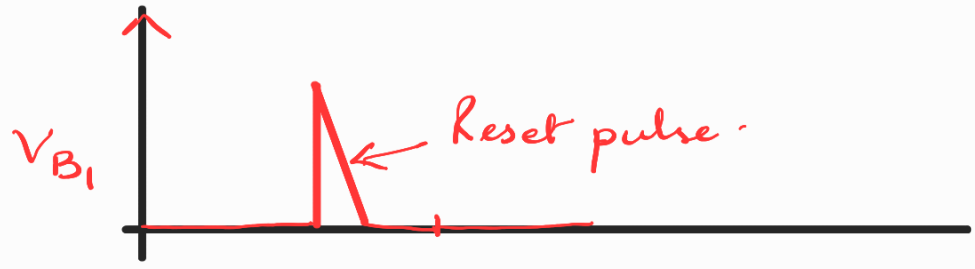
1.) V_{cc} is supplied, one transistor will start conducting more than other. Then because of the feedback action, this transistor will be driven into saturation and other in cut off.

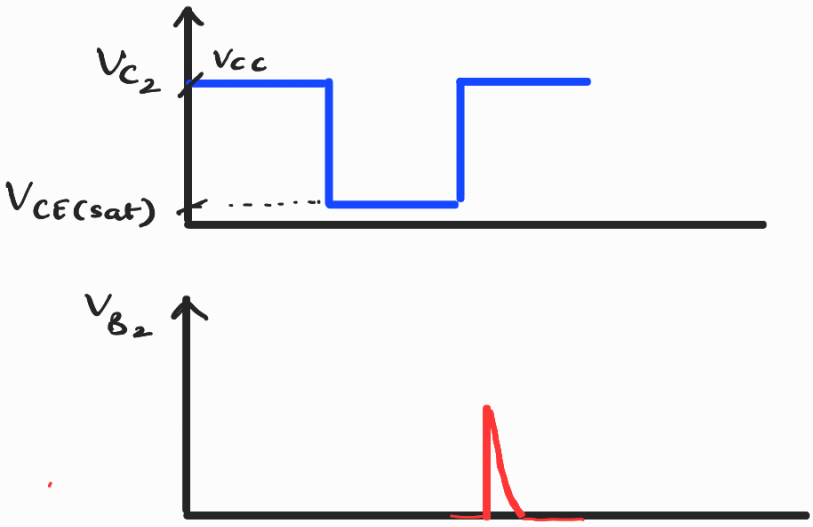
2.) Let us assume that the transistor Q_1 is in saturation (i.e ON) and Q_2 (i.e; OFF). This is the stable state of the ckt and will remain in this state. till a next trigger pulse is applied from outside. A negative pulse at the set I/P will turn OFF Q_1 and turn ON Q_2.

3.) Suppose a +ve pulse is applied at reset I/P. It will cause Q_2 to conduct and Q_1 turns OFF. Thus the circuit switches from one state to another stable state.

4.) Now, if a +ve pulse is applied to the set I/P it will switch the circuit back to its its original state.







APPLICATIONS OF MULTIVIBRATORS

Used in variety of electronic circuit such as computer, control system and communication systems.

Astable multivibrator – square waveform generators, voltage to frequency converters.

Monostable multivibrator – variable pulse width.

Bistable multivibrator – memory, counters.