Dr. MD. Aslam, Dept. Of physics,
B.Sc.part-2, physics (Hons) paper-iv
Lecture No-49

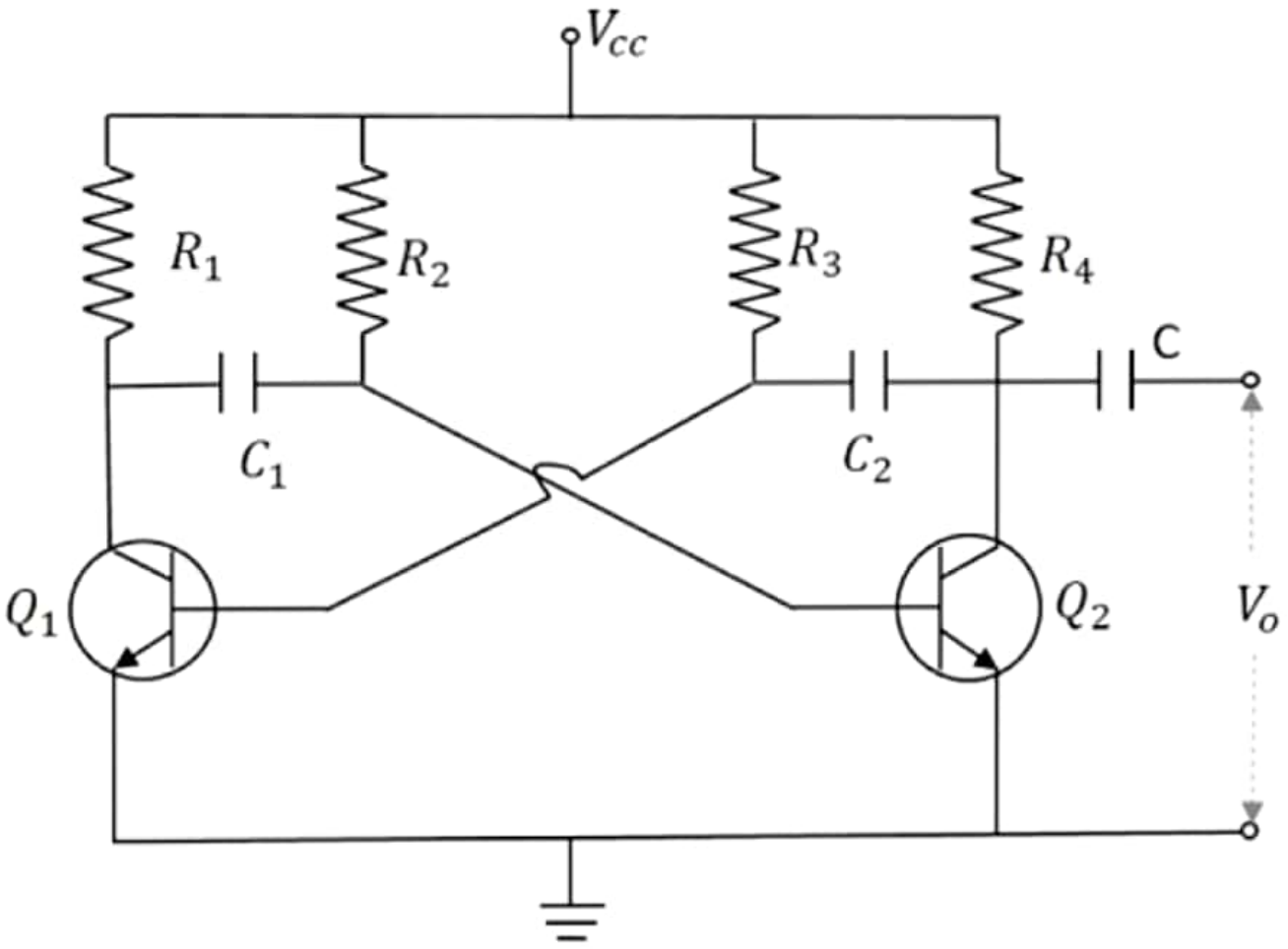
Topic: Astable Multivibrator

An astable multivibrator has **no stable states**. Once the Multivibrator is ON, it just changes its states on its own after a certain time period which is determined by the R_C time constants. A dc power supply or V_{cc} is given to the circuit for its operation.

Construction of Astable Multivibrator

Two transistors named Q_1 and Q_2 are connected in feedback to one another. The collector of transistor Q_1 is connected to the base of transistor Q_2 through the capacitor C_1 and vice versa. The emitters of both the transistors are connected to the ground. The collector load resistors R_1 and R_4 and the biasing resistors R_2 and R_3 are of equal values. The capacitors C_1 and C_2 are of equal values.

The following figure shows the circuit diagram for Astable Multivibrator.



Operation of Astable Multivibrator

When V_{cc} is applied, the collector current of the transistors increase. As the collector current depends upon the base current,

$$I_c = \beta I_B$$

As no transistor characteristics are alike, one of the two transistors say Q_1 has its collector current increase and thus conducts. The collector of Q_1 is applied to the base of Q_2 through C_1. This connection lets the increased negative voltage at the collector of Q_1 to get applied at the base of Q_2 and its collector current decreases. This continuous action makes the collector current of Q_2 to decrease further. This current when applied to the base of Q_1 makes it more negative and with the cumulative actions Q_1 gets into saturation and Q_2 to cut off. Thus the output voltage of Q_1 will be $V_{CE\ (sat)}$ and Q_2 will be equal to V_{CC}.

The capacitor C_1 charges through R_1 and when the voltage across C_1 reaches 0.7v, this is enough to turn the transistor Q_2 to saturation. As this voltage is applied to the base of Q_2, it gets into saturation, decreasing its collector current. This

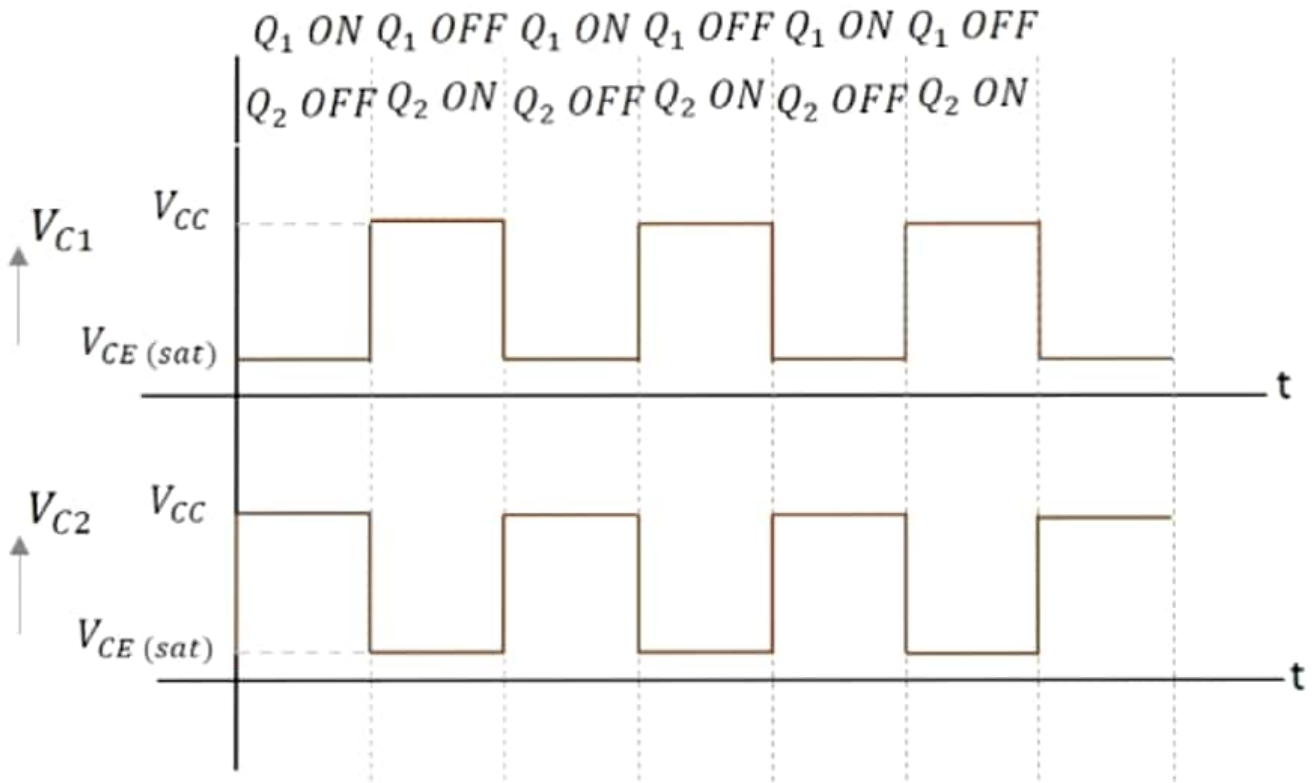
reduction of voltage at point B is applied to the base of transistor Q_1 through C_2 which makes the Q_1 reverse bias. A series of these actions turn the transistor Q_1 to cut off and transistor Q_2 to saturation. Now point A has the potential V_{CC}. The capacitor C_2 charges through R_2. The voltage across this capacitor C_2 when gets to 0.7v, turns on the transistor Q_1 to saturation.

Hence the output voltage and the output waveform are formed by the alternate switching of the transistors Q_1 and Q_2. The time period of these ON/OFF states depends upon the values of biasing resistors and capacitors used, i.e., on the R_C values used. As both the transistors are operated alternately, the output is a square waveform, with the peak amplitude of V_{CC}.

Waveforms

The output waveforms at the collectors of

Q_1 and Q_2 are shown in the following figures.



Frequency of Oscillations

The ON time of transistor Q_1 or the OFF time of transistor Q_2 is given by

$$t_1 = 0.69R_1C_1$$

Similarly, the OFF time of transistor Q_1 or ON time of transistor Q_2 is given by

$$t_2 = 0.69R_2C_2$$

Hence, total time period of square wave

$$t = t_1 + t_2 = 0.69(R_1C_1 + R_2C_2)$$

As $R_1 = R_2 = R$ and $C_1 = C_2 = C$, the frequency of square wave will be

$$f = \frac{1}{t} = \frac{1}{1.38RC} = \frac{0.7}{RC}$$

Advantages

The advantages of using an astable multivibrator are as follows −

- No external triggering required.
- Circuit design is simple
- Inexpensive
- Can function continuously

Disadvantages

The drawbacks of using an astable multivibrator are as follows −

- Energy absorption is more within the circuit.
- Output signal is of low energy.
- Duty cycle less than or equal to 50% can’t be achieved.

Applications

Astable Multivibrators are used in many applications such as amateur radio equipment, Morse code generators, timer circuits, analog circuits, and TV systems.