# SNS COLLEGE OF TECHNOLOGY

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# Department of Biomedical Engineering

**Course Name: 23BMB101-Electron Devices and Circuits**

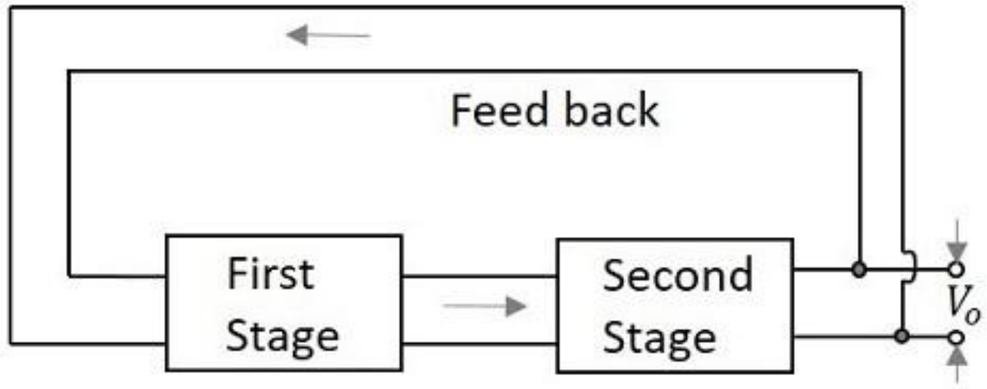
**I Year : II Semester**

**Unit IV –Power Amplifiers & Switching Circuits**

**Topic :** Multivibrators - Astable

# INTRODUCTION

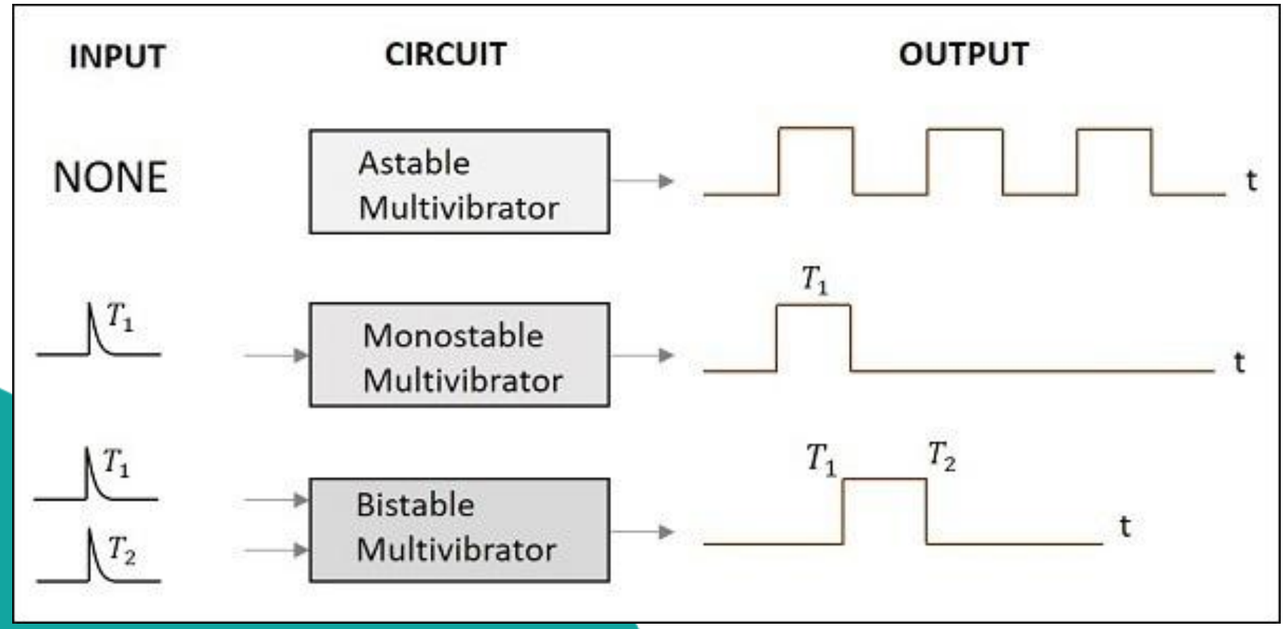
- A MULTIVIBRATOR is an electronic circuit that generates square, rectangular, pulse waveforms, also called nonlinear oscillators or function generators.
- Multivibrator is basically a two amplifier circuits arranged with regenerative feedback.
- A Multivibrator is a two-stage resistance coupled amplifier with positive feedback from the output of one amplifier to the input of the other.
- Two transistors are connected in feedback so that one controls the state of the other. Hence the ON and OFF states of the whole circuit, and the time periods for which the transistors are driven into saturation or cut off are controlled by the conditions of the circuit.



# Multivibrators

There are two possible states of a Multivibrator. In first stage, the transistor Q1 turns ON while the transistor Q2 turns OFF. In second stage, the transistor Q1 turns OFF while the transistor Q2 turns ON.

- Depending upon the manner in which these two states are interchanged, the Multivibrators are classified into three types.

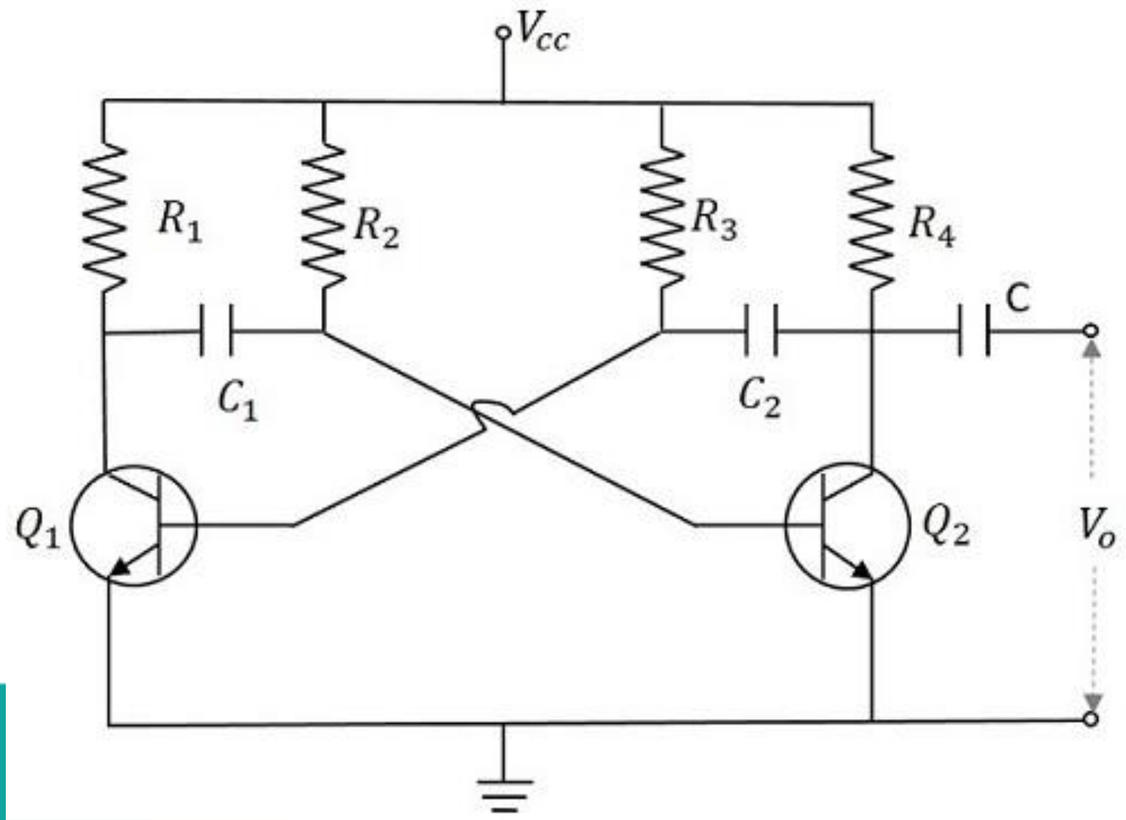



Circuit is not stable in either state—it continuously oscillates from one state to the other. (Oscillators)

One of the state is stable but the other is not. (Timer)

Circuit is stable in both the state and will remain in either state indefinitely. (Flip flop)

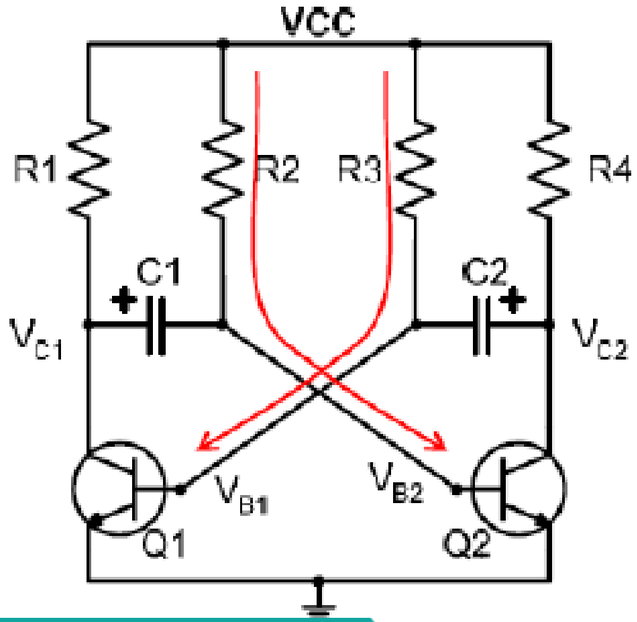
# Astable Multivibrator

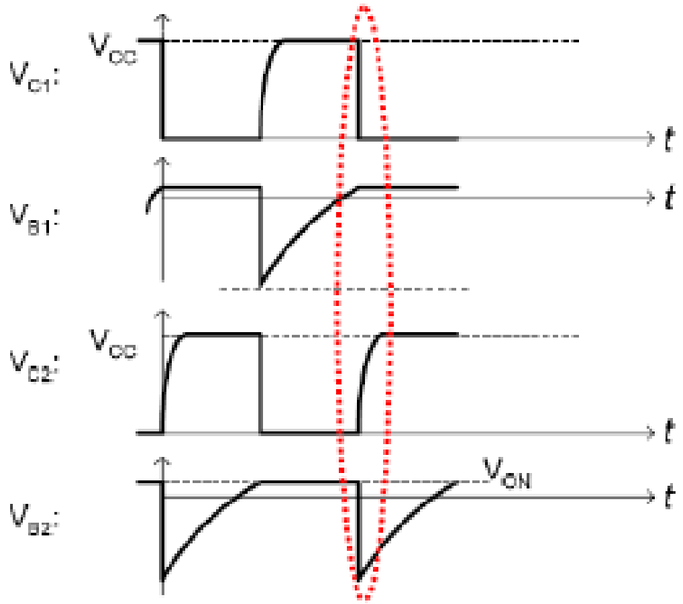



- An astable multivibrator has no stable states. Once the Multivibrator is ON, it just changes its states on its own after a certain time period which is determined by the RC time constants.
- Two transistors named Q1 and Q2 are connected in feedback to one another.
- The collector of transistor Q1 is connected to the base of transistor Q2 through the capacitor C1 and vice versa.
- The emitters of both the transistors are connected to the ground.
- The collector load resistors R1 and R4 and the biasing resistors R2 and R3 are of equal values. The capacitors C1 and C2 are of equal values.

# Astable Multivibrator

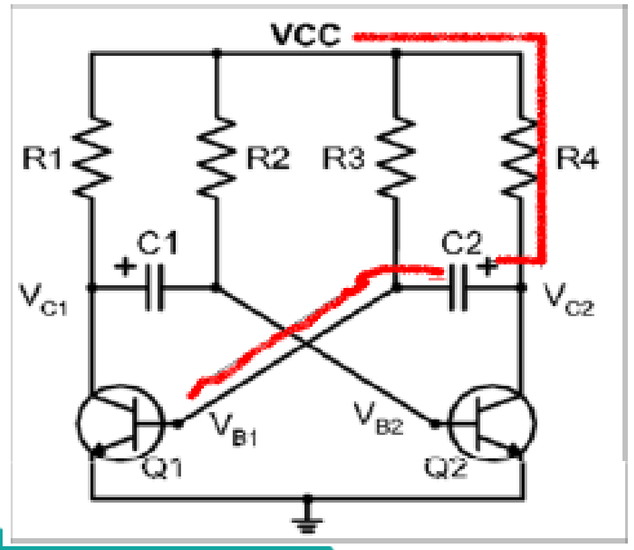
- When the circuit is first powered up, neither transistor is ON.
- Both VB1 and VB2 rise via base resistor R3 and R2 respectively. Any one of the transistor will conduct faster than other due to some circuit imbalance. We can not say which transistor will turn on first so for analysis purpose we assume Q1 conducts first and Q2 off (C1 is fully charged).
- Since Q1 conducts and Q2 off hence Vc1 = 0V and Vc2 = VCC. - state1

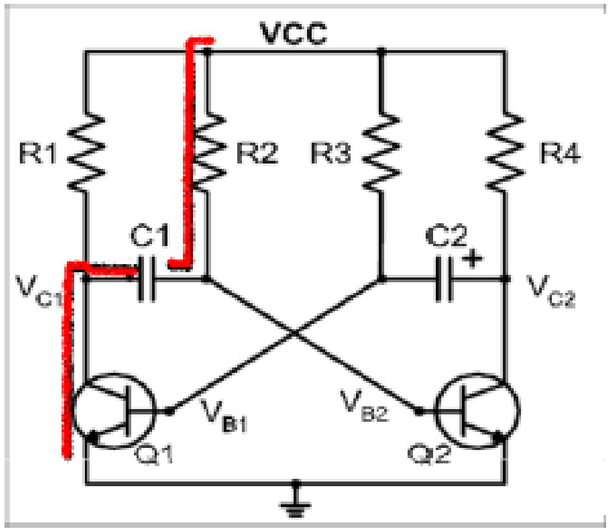


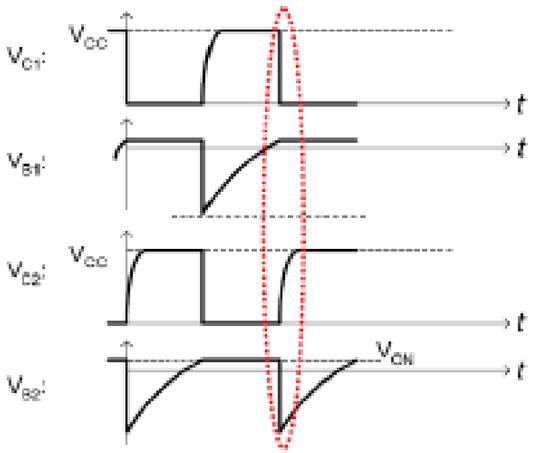



# Astable Multivibrator

- Due to higher voltage at Vc2, capacitor C2 will be charged via R4 (low resistance path because R4 <R2). C1 (which was charged earlier, and can not hold the charge for indefinite period) starts discharging via R2 (high resistance path because R2>R1). Time taken to discharge C1(T1 = R2C1) > time taken to charge C2 (T2 =R4C2).
- When C2 is fully charged then left plate of C2 will be at –Vcc which switch off the Q1. When C1 is fully discharged then left plate of C1 will be at +Vcc which switch on the Q2. – State 2



# Astable Multivibrator

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

$$\mathbf{t_1 = 0.69 R_1 C_1}$$

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

$$\mathbf{t_2 = 0.69 R_2 C_2}$$

- Hence, total time period of square wave

$$\mathbf{t = t_1 + t_2 = 0.69(R_1 C_1 + R_2 C_2)}$$

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

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