ASTABLE MULTIVIBRATOR

ASTABLE MULTIVIBRATOR
LECTURE-2
TDC PART I
PAPER II (GROUP- B)
CHAPTER 3

By MINAKSHI
ASSISTANT PROFESSOR (GUEST FACULTY)
Department of Electronics
LANGAT SINGH COLLEGE, MUZAFFARPUR

ASTABLE MULTIVIBRATOR

In astable multivibrator there is no stable state i.e the output of the circuit continuously changes between the two states.The duration for which the output remains in a particular state depends on the passive components like capacitors, resistors e.t.c.

ASTABLE MULTIVIBRATOR

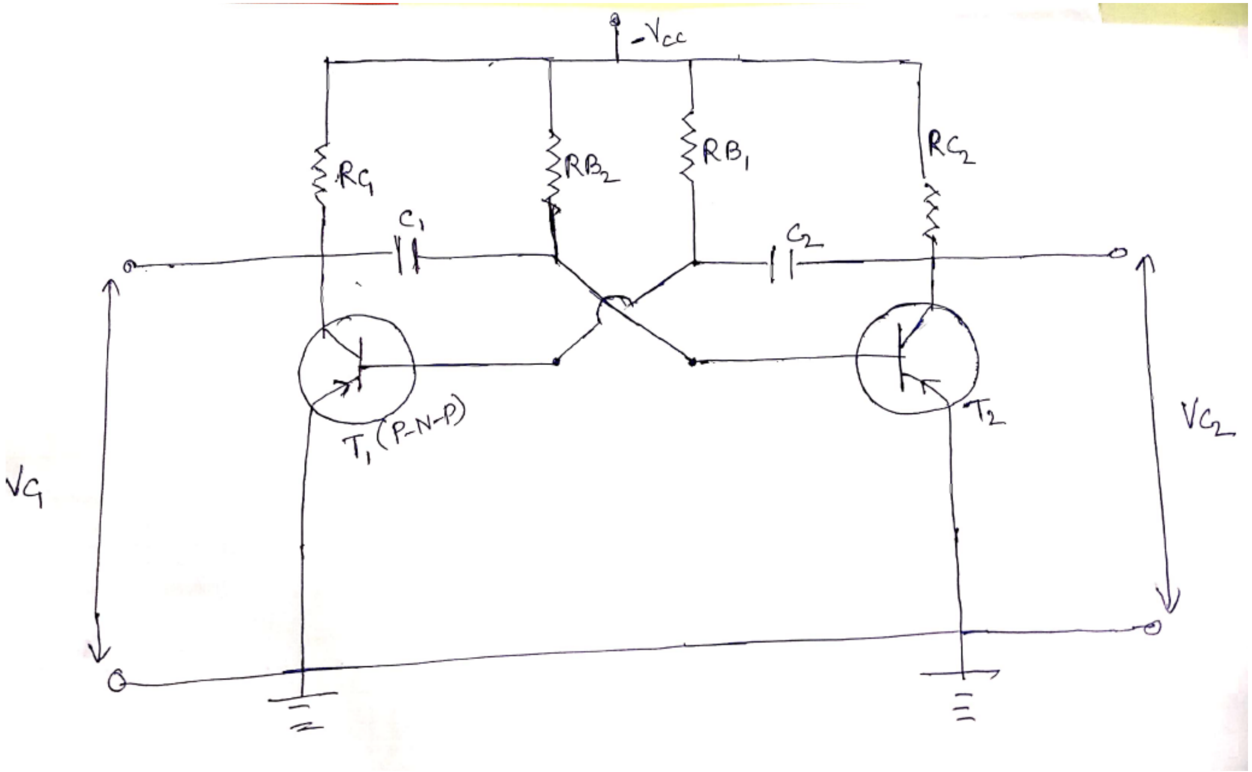
Thus astable multivibrators are free running oscillators which oscillate between two states continuously producing two square wave output waveforms which is used to flash lights or produce a sound in a loudspeaker.

It provides continuous switching between the two states without applying any external triggering pulse.

Construction of astable multivibrator using BJT

The basic transistor circuit for an astable multivibrator consists of two switching transistors, a cross coupled feedback network and two time delay capacitors which allows oscillation between the two states with no external trigging to produce the change in state.

ASTABLE MULTIVIBRATOR (CIRCUIT DIAGRAM)



ASTABLE MULTIVIBRATOR

- Astable multivibrator has no stable state but the circuit has two quasi stable states.
- Transistors T1 ‘on’ and T2 “off” Tt makes periodic transition between these states without any external triggering.
- In figure,
- RC1 and RC2 = collector Resistor for T1 and T2 respectively.
- RB1 and RB2= provide one stage base current to T1 and T2 respectively C1 & C2 are coupling capacitors.

ASTABLE MULTIVIBRATOR (WORKING)

When the power is applied, let due to some circuit disturbance [inbalance], current flowing through T1 is more than the current flowing through T2 .Due to this, the rate of fall of Vc1 is more than that of Vc2 .The change of Vc1 makes the base of the transistor T2 more negative. The Vc2 increases and approaches to Vcc.The increase in Vc2 will be transformed to the base of T1 via C2. So the conduction of T1 further increases.

This further reduces the collector voltageVc1 which makes the base of T2 more negative, thereby further reducing its conduction. Thus due to the +ve feedback action, T1 comes in saturated region and T2 comes in cut-off region . The circuit settles down momentarily with T1 in saturation and T2 in cut-off. This is only a quasi stable state. In this stage, Vc1 approximately equal to 0 and Vc2 approximately equal to Vcc.

This permits the charging of c2 through Rc2 and the base emitter junction of T1 comes to a potential approximately equal to Vcc. Meanwhile the condenser c1 discharges through T1 and RB2. This decreases the reverse bias on the base of T2 and after sometime, it starts conducting. The collector voltage Vc2 begins to fall. The falling collector voltage is communicated to the base of T1 via c2.

This causes the reduction of base voltage of T1 and consequently there is an increase in collector voltage Vc1 which is communicated to the base of T1 via c1 .The conduction of T2 increases. The regenerative process continues till the transistor T2 is in saturated region and T1 is in cut-off region.

Under this condition,

$$V_{c1} = V_{cc} \text{ and } V_{c2} = 0$$

This process is repeated again and again as long as the supply voltage is present.

The amplitude of the output waveform is approximately the same as the supply voltage, Vcc with the time period of each switching state determined by the time constant of the RC networks connected across the base terminals of the transistors. As the transistors are switching both “on” and “off”, the output at either collector will be square wave with slightly rounded corners because of the current which charges the capacitors.

If the two time constants produced by C2 xRB2 and C1 xRB1 in the base circuits are the same, the mark to space ratio [t1/t2] will be equal to one-to-one making the output waveform symmetrical in shape. By varying the capacitors C1 ,C2 or the resistors,RB1 ,RB2 the mark to space ratio and therefore frequency can be altered.

We saw in the RC Discharging, the time taken across a capacitor to fall to half the supply voltage,0.5Vcc is equal to 0.69 times constant of the capacitor and resistor combination.

Then taking one side of the astable multivibrator, the length of the time that transistor T2 is "off" will be equal to 0.69T or 0.69 times the constant of c1 x RB1. Likewise the length of time that transistor T1 is "off" will be equal to 0.69T or 0.69 times the time constant of c2x RB2 and this is defined as

"ASTABLE MULTIVIBRATORS PERIODIC TIME"

Periodic Time, $T = t1 + t2$

$$t1 = 0.69 c1 RB1$$

$$t2 = 0.69 c2 RB2$$

Where, R is in ohm and c in Farads.

By altering the time constant of just one RC network the mark to space ratio and frequency of the output waveform can be changed but normally by changing both RC time constants together at the same time, the output frequency will be altered keeping the mark to space ratios the same at one- to-one. If the value of the capacitor c1 equals the value of the capacitor, c2 and also the value of the base RB1 =RB2 then the total length of time of the Multivibrators cycle is given below for a symmetrical output waveform.

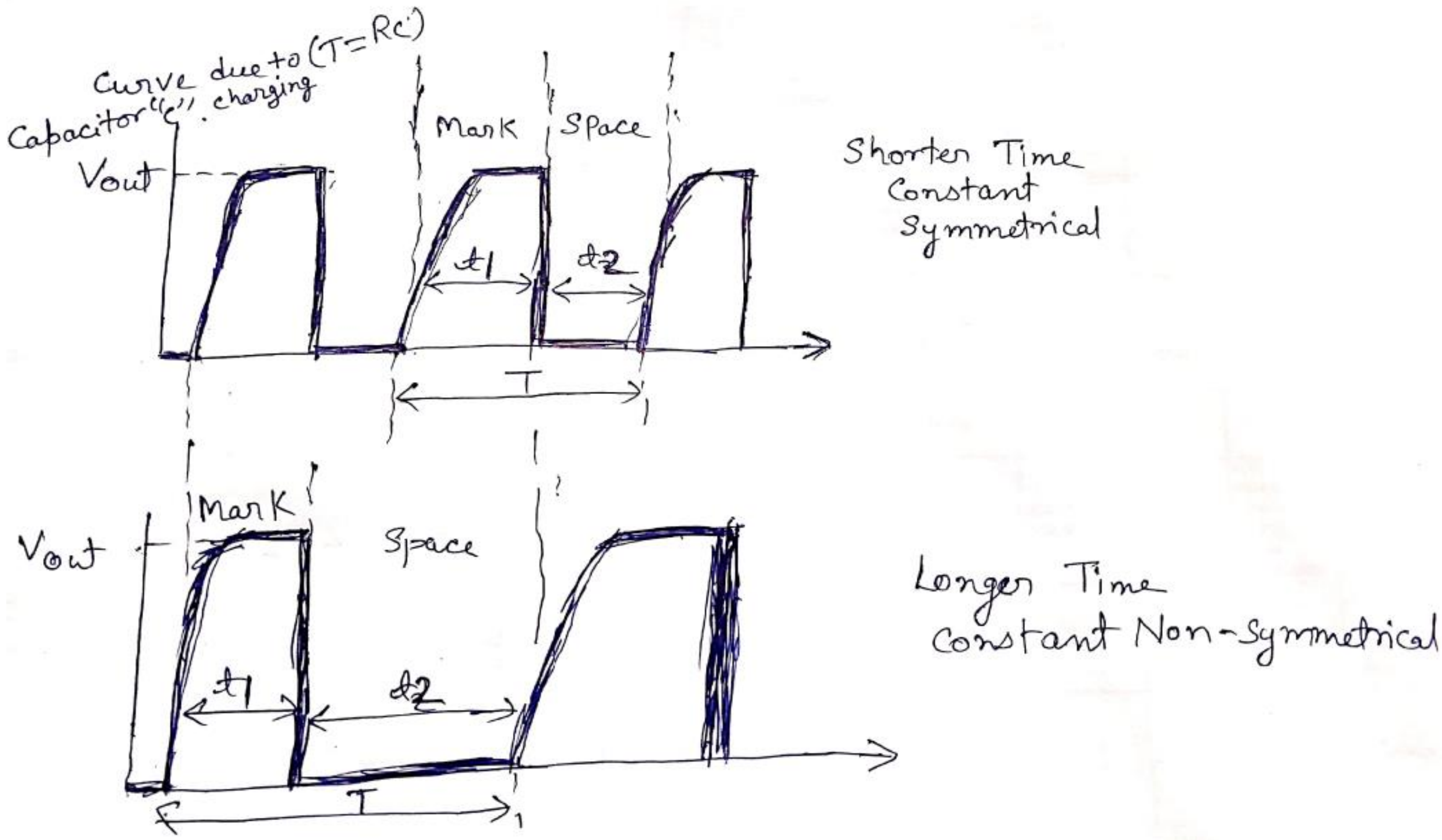
Frequency of Oscillation

$$f=1/T=1/1.38RC$$

Where, R is in Ohms, c is in Farads,T is in seconds and f is in Hertz.This is known as the "Pulse Repetition Frequency".

So Astable Multivibrators can produce two very short square wave output waveforms from each transistor or a much longer rectangular shaped output either symmetrical or non symmetrical depending upon the time constant of the RC network.

ASTABLE MULTIVIBRATORS WAVEFORM (GRAPH)



VOLTAGE TIME GRAPH