Analog Electronic Circuits
(UEC301)

By

Dr.Mayank Kumar Rai
Associate Professor,
ECED,TIET,Patiala

Thapar Institute of Engineering & Technology
(Deemed to be University)
Bhadson Road, Patiala, Punjab, Pin-147004
Contact No. : +91-175-2393201
Email : info@thapar.edu

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

Subject: Analog Electronic Circuits (UEC301)

Faculty name: Dr. Mayank Kumar Rai (Associate Professor & Course Coordinator)

Topic of today's Lecture : Multivibrator-I &II

Key points

- ✓ **Switching Action of a BJT**
- ✓ **Multivibrator**
- ✓ **Types of Multivibrator**
- ✓ **Astable (Free running) Multivibrator**
- ✓ **Monostable Multivibrator**
- ✓ **Bistable Multivibrator**

Contents of this lecture are based on the following books:

- *Jacob Milman & and C.C.Halkias,* ***"Integrated Electronics Analog and Digital Circuit and Systems"****Second Edition.*
- *Adel S. Sedra & K. C. Smith,* ***"MicroElectronic Circuits Theory and Application"*** *Fifth Edition.*
- *Robert L. Boylestad & L. Nashelsky,* ***"Electronic Devices and Circuit Theory"*** *Eleventh Edition.*

Switching Action of a BJT

➢ ***A transistor which is used as a switch is known as a switching transistor.***

i. OFF Region or cut off region

Power loss = (Output voltage) X (Output current)

Power loss = $V_{CC}.I_{CEO}$

ii. ON Region or Saturation Region

$$V_{CE} = V_{CC} - I_{Csat}R_C \quad \text{where } V_{CE} = V_{knee}$$

$$I_{Csat} = \frac{V_{CC} - V_{knee}}{R_C}$$

Power loss = $V_{knee}.I_{Csat}$

iii. Active Region

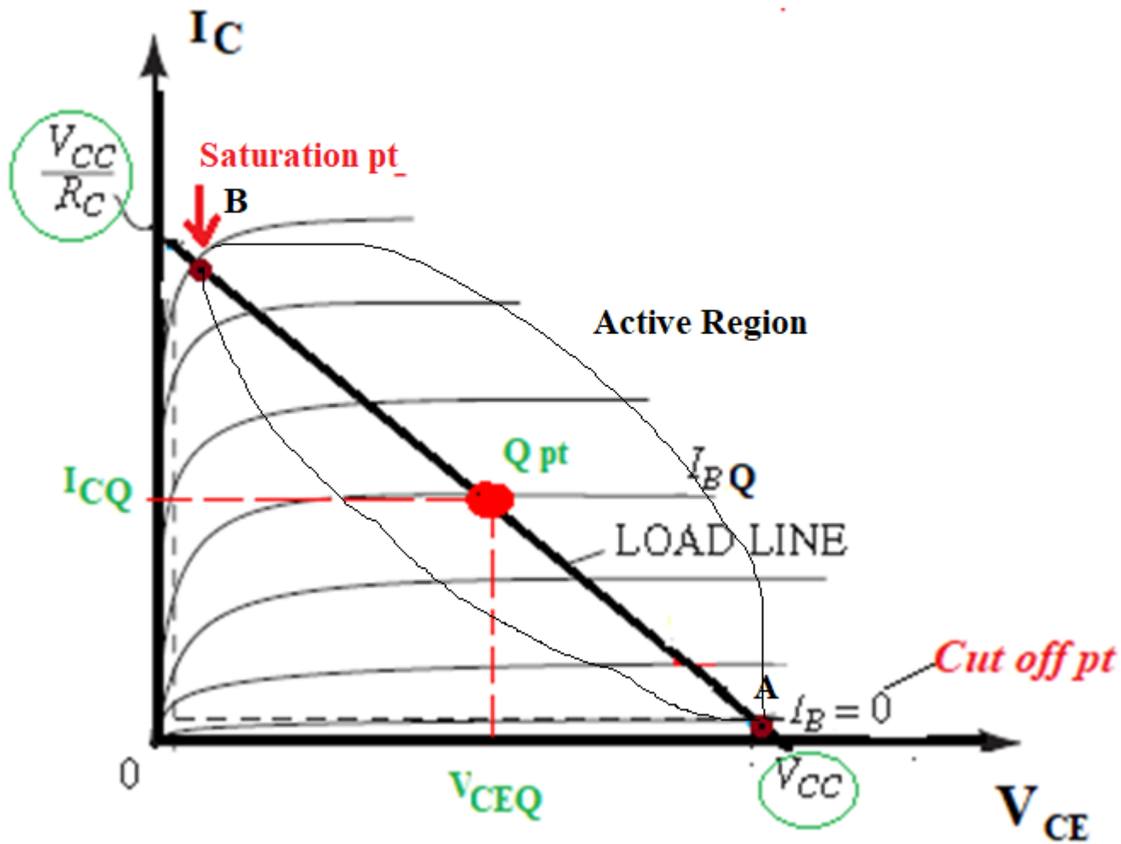

Figure 1: Output characteristics. Of npn transistor.

Multivibrator

A electronic circuit that generates square waves or other non-sinusoidal such as rectangular ,saw-tooth waves is known as a ***Multivibrator.***

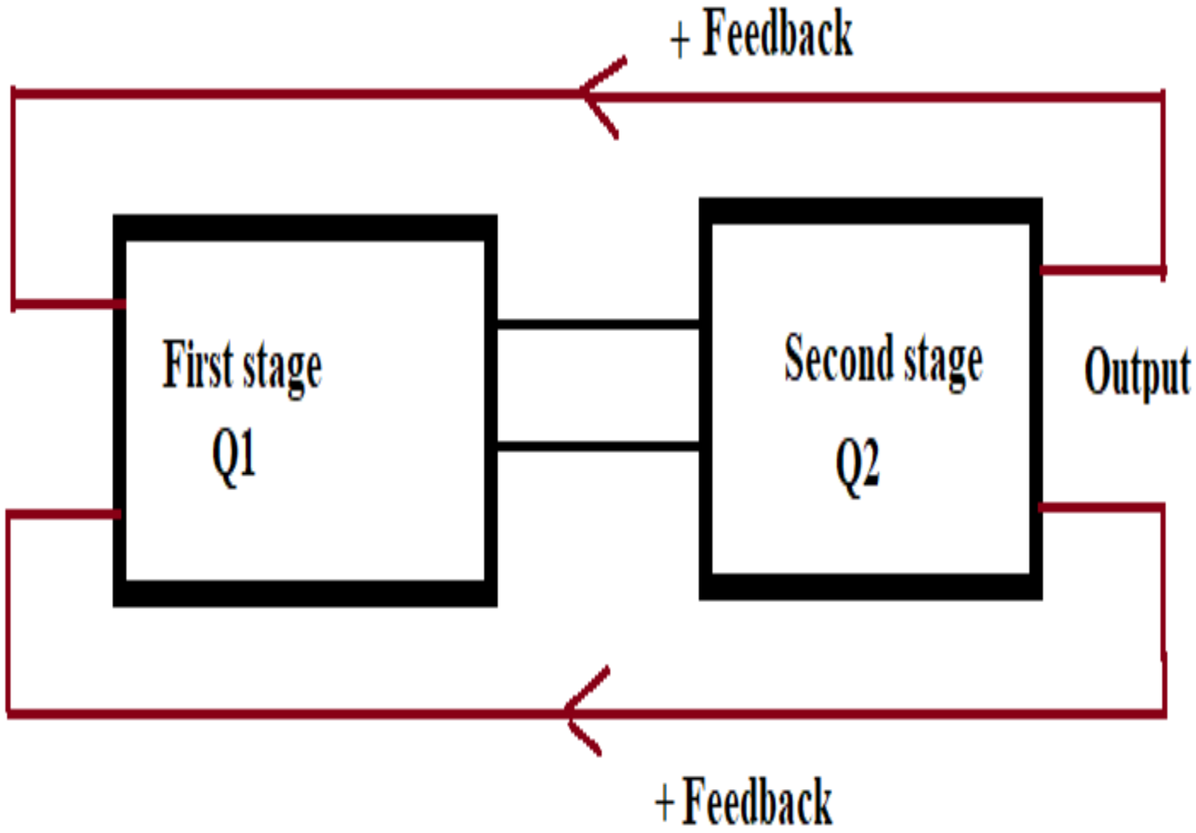

Figure 2: Block diagram of multivibrator.

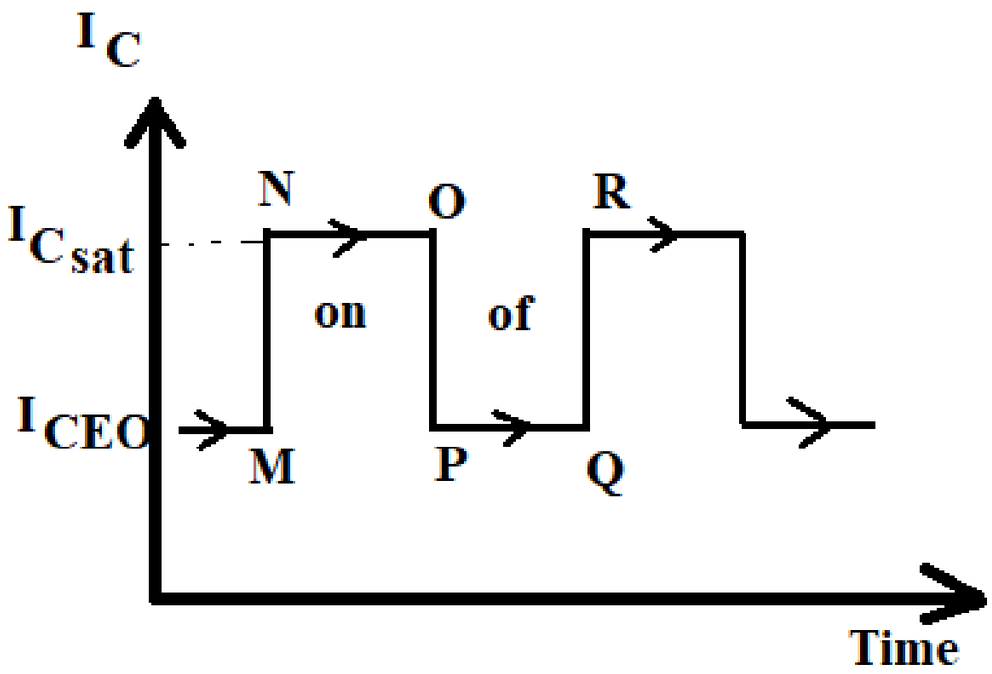

Figure 3:Waveform of Output current.

Types of Multivibrator

State	On	OF
First state	Q1	Q2
Second state	Q2	Q1

i. *Astable or free running multivibrator*
ii. *Monostable or one-shot multivibrator*
iii. *Bi-stable or flip flop multivibrator*

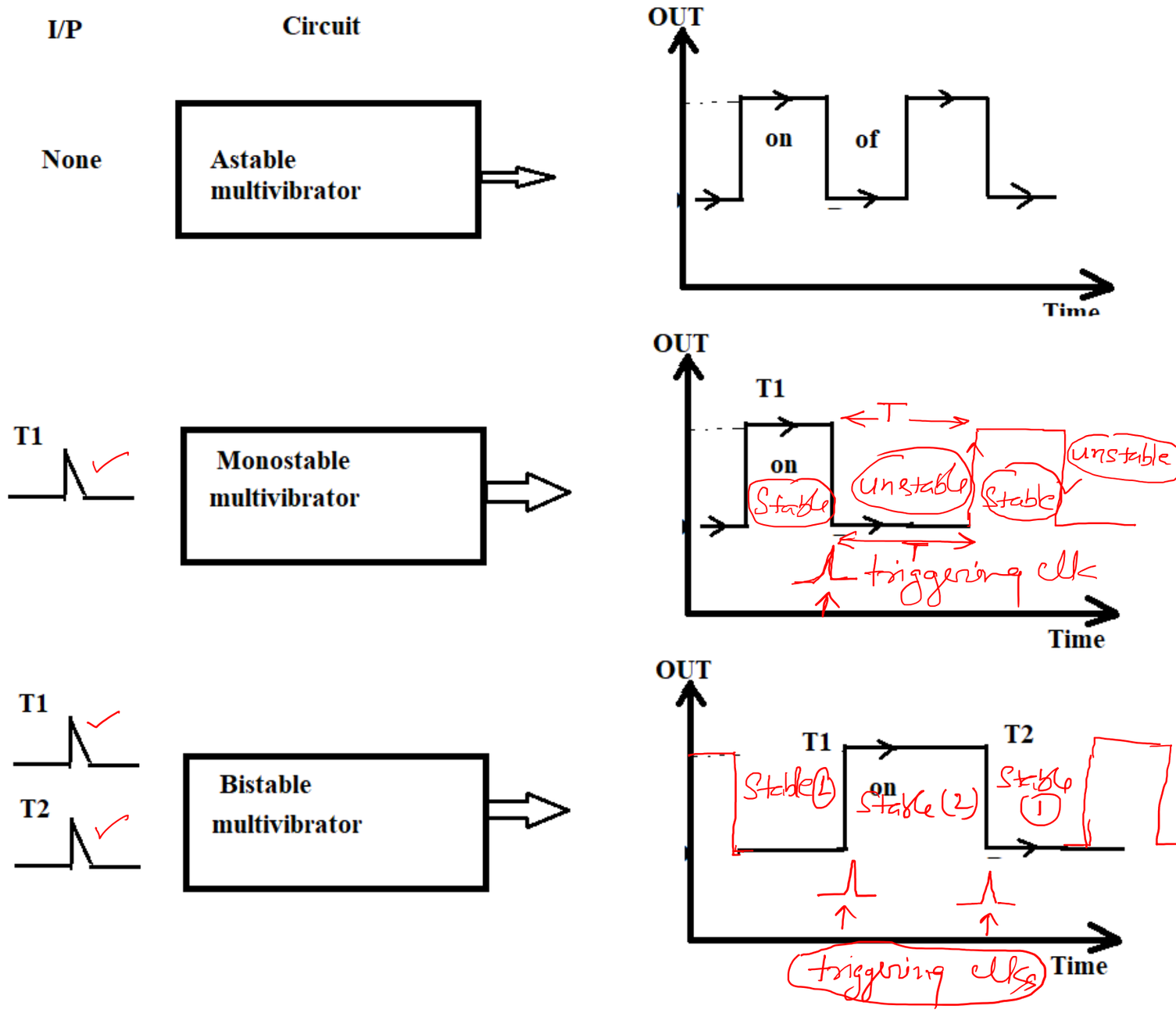

Figure 4: Input output relation of different types of multivibrator.

Astable Multivibrator ***:*** *A multivibrator which generates square waves of its own is called as an astable or free running multivibrator.*

Circuit Details:

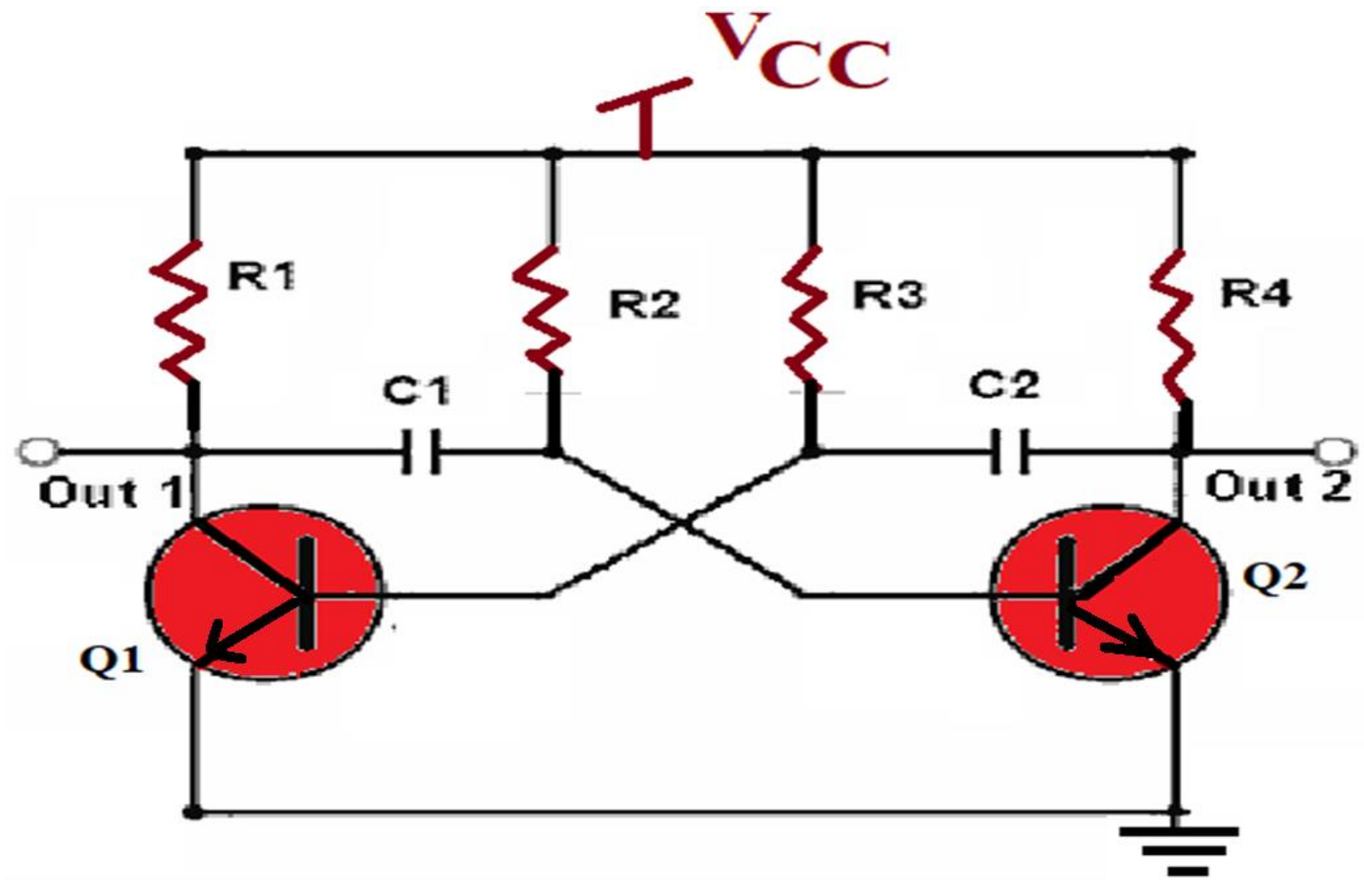

Figure 5: Astable multivibrator.

Operation

ON or OFF time: *The time for which either transistor remain ON or OFF*

ON time for Q_1:

$T_1 = 0.694\ R_2.C_1$

OFF time for Q_1:

$T_2 = 0.694\ R_3.C_2$

Total time period of the square wave:

$T = T_1 + T_2 = (0.694\ R_2.C_1 + 0.694\ R_3.C_2)$

Frequency of the square wave,

$$f = \frac{1}{T}$$

Monostable Multivibrator : *A multivibrator in which one transistor is always conducting and other is non conducting is called* ***monostable multivibrator.***

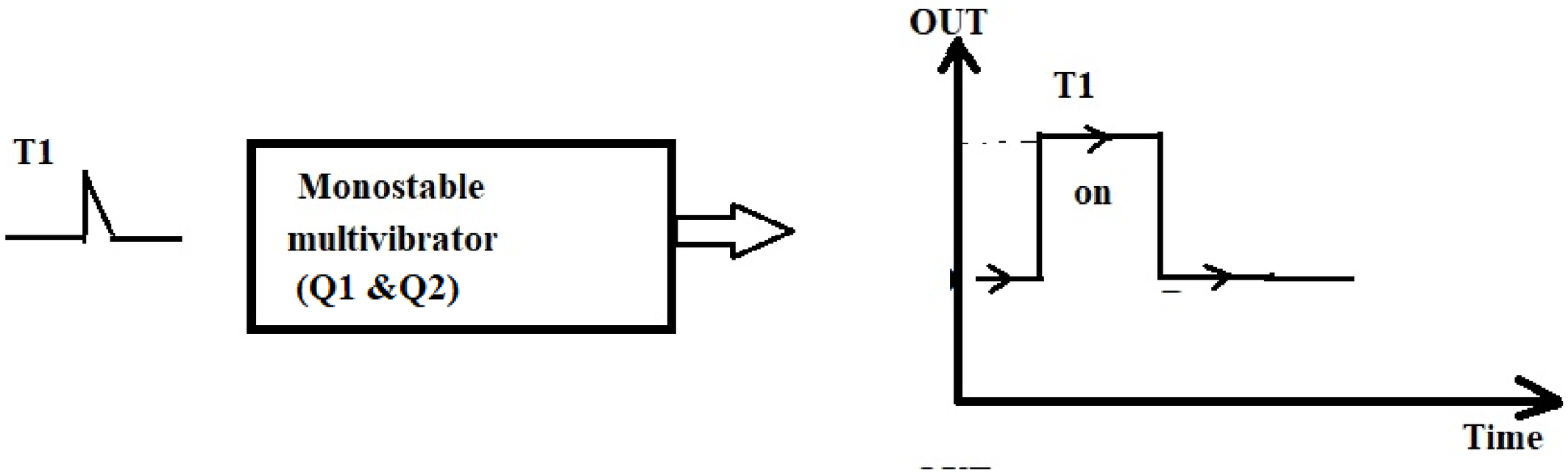

Figure 1: Circuit diagram of monostable multivibrator.

Circuit Details:

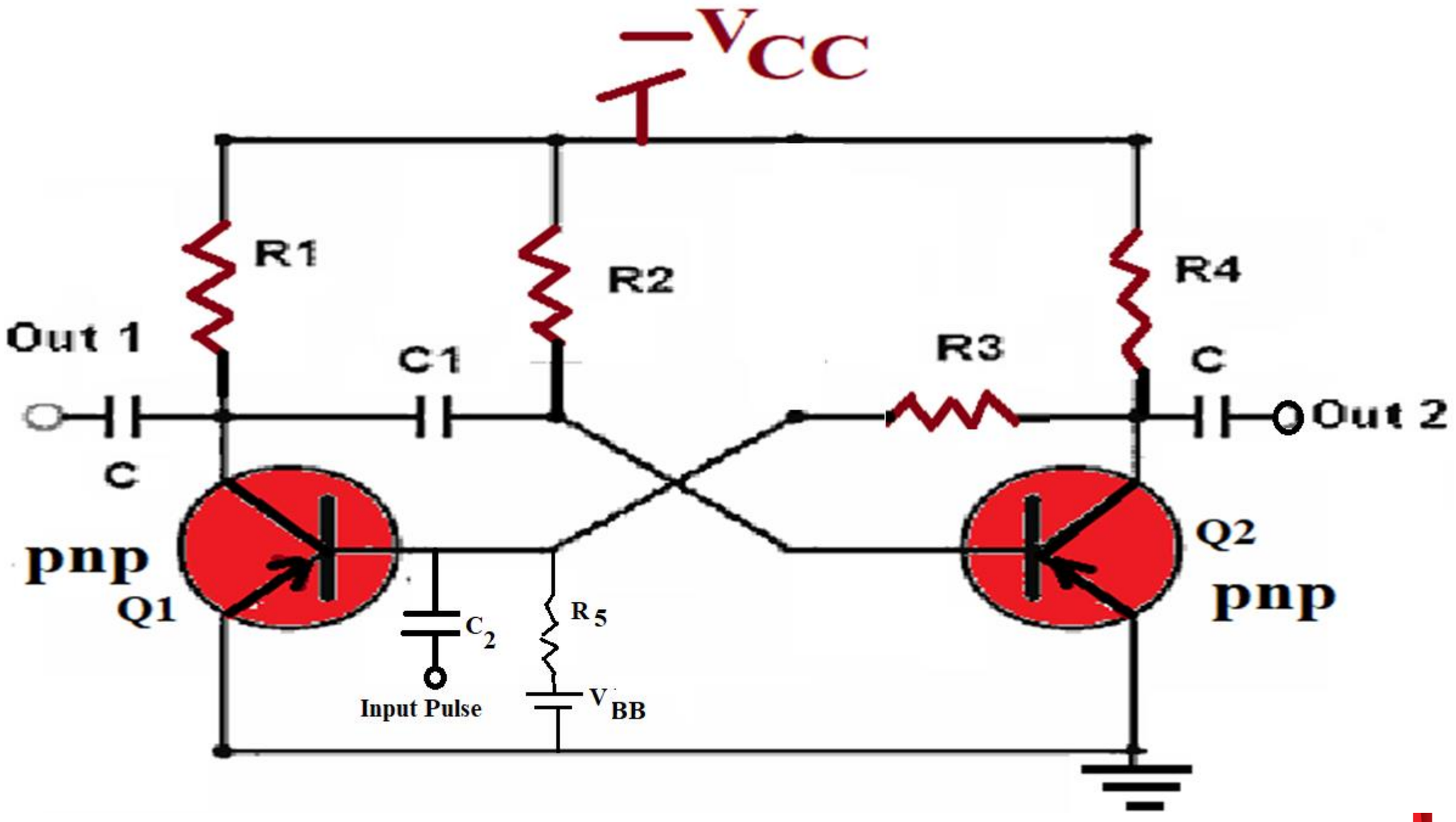

Figure 2: Circuit diagram of Monostable multivibrator.

Operation:

Step 1:

✓ *Intially we assume that the* ***Q1 is at cut off*** *and* ***Q2 is at saturation.***

✓*We apply negative triggering pulse*

✓*C1 is charged up to Vcc.*

Step 2:

✓***C1 is discharged***

✓ ***Q1 is driven to saturation and Q2 to cut off***

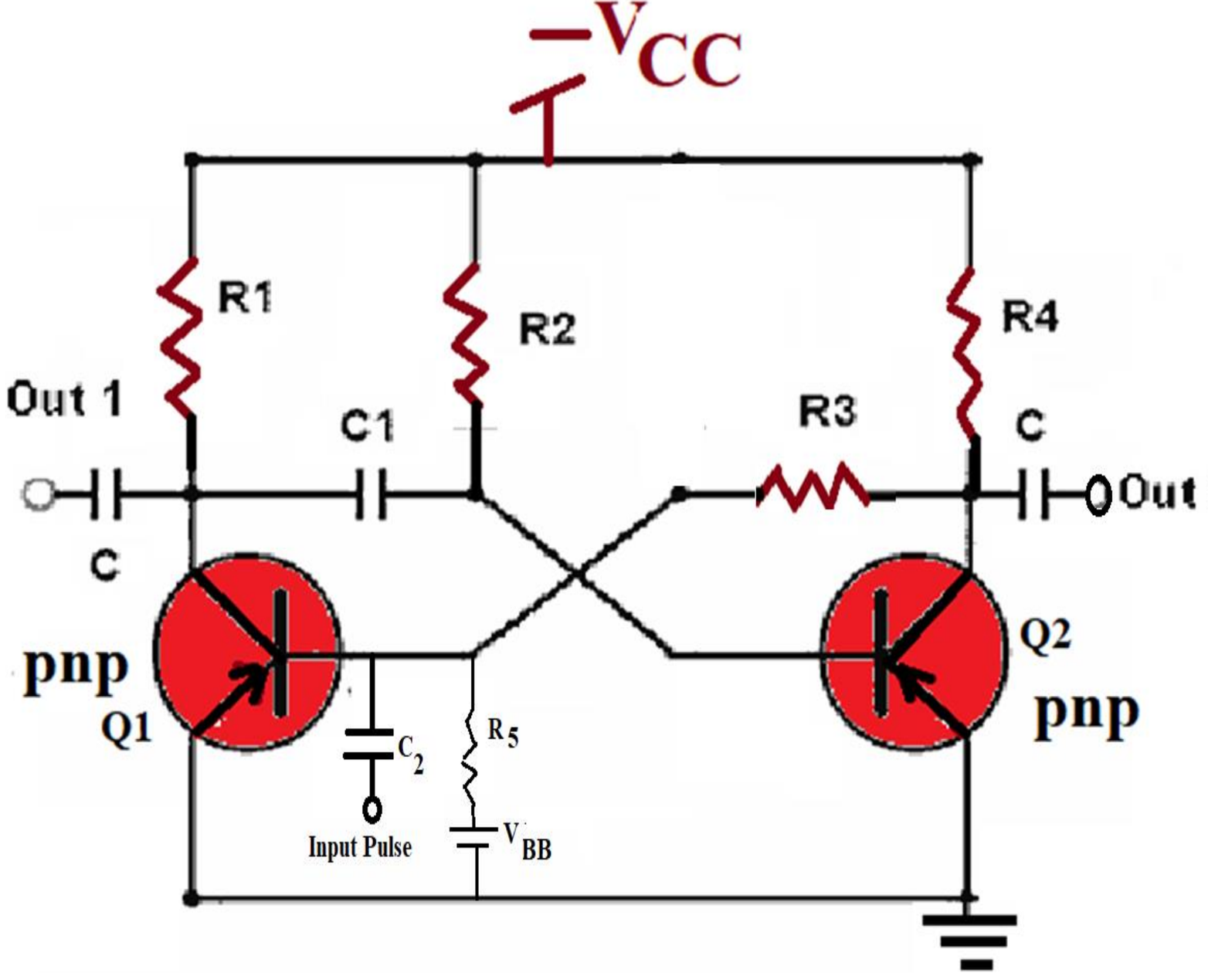

Figure 3: Operation of Monostable multivibrator.

Bistable Multivibrator ***:*** *A multivibrator which has both the states stable is called* ***Bistable multivibrator.***

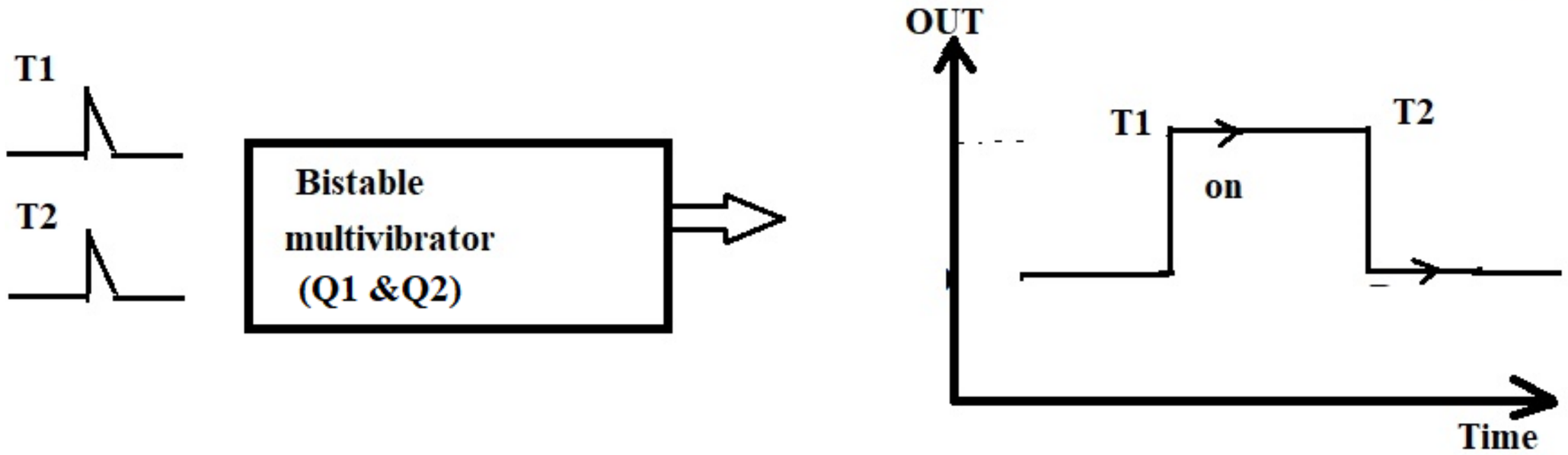

Figure 4: Block diagram of bistable multivibrator.

Circuit Details

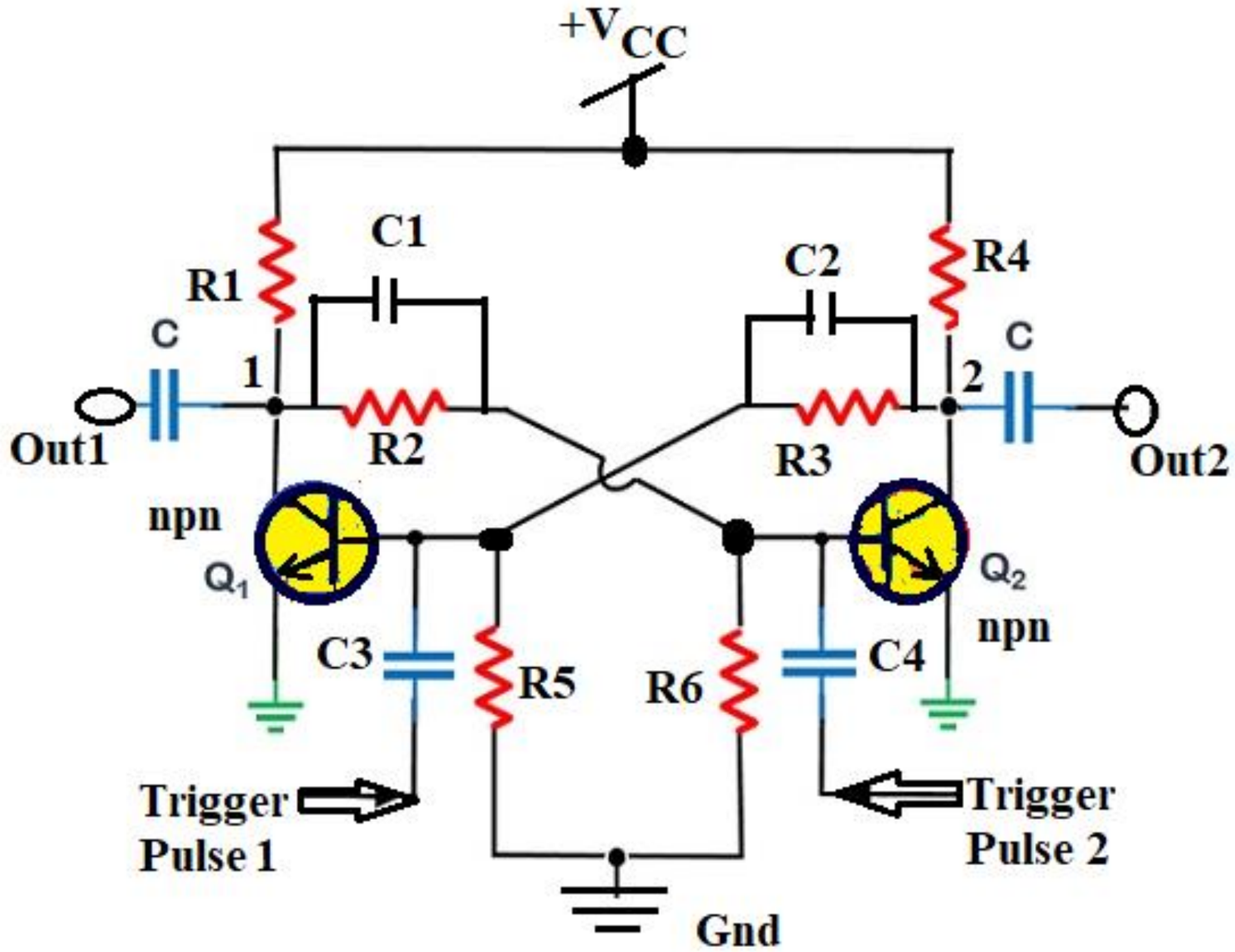

Figure 5: Circuit diagram of bistable multivibrator.

Operation:

Step 1:

- ✓ ***Q1 is on and Q2 is off***
- ✓ ***And we apply negative pulse to the base of Q1***
- ✓ ***Q1 is driven to cut off and Q2 to saturation(on).***

Step 2:

- ✓ ***Another negative pulse is applied to the base of Q2***
- ✓ ***Q1 & Q2 will come to original sates. (i.e. Q1 is on and Q2 is off)***

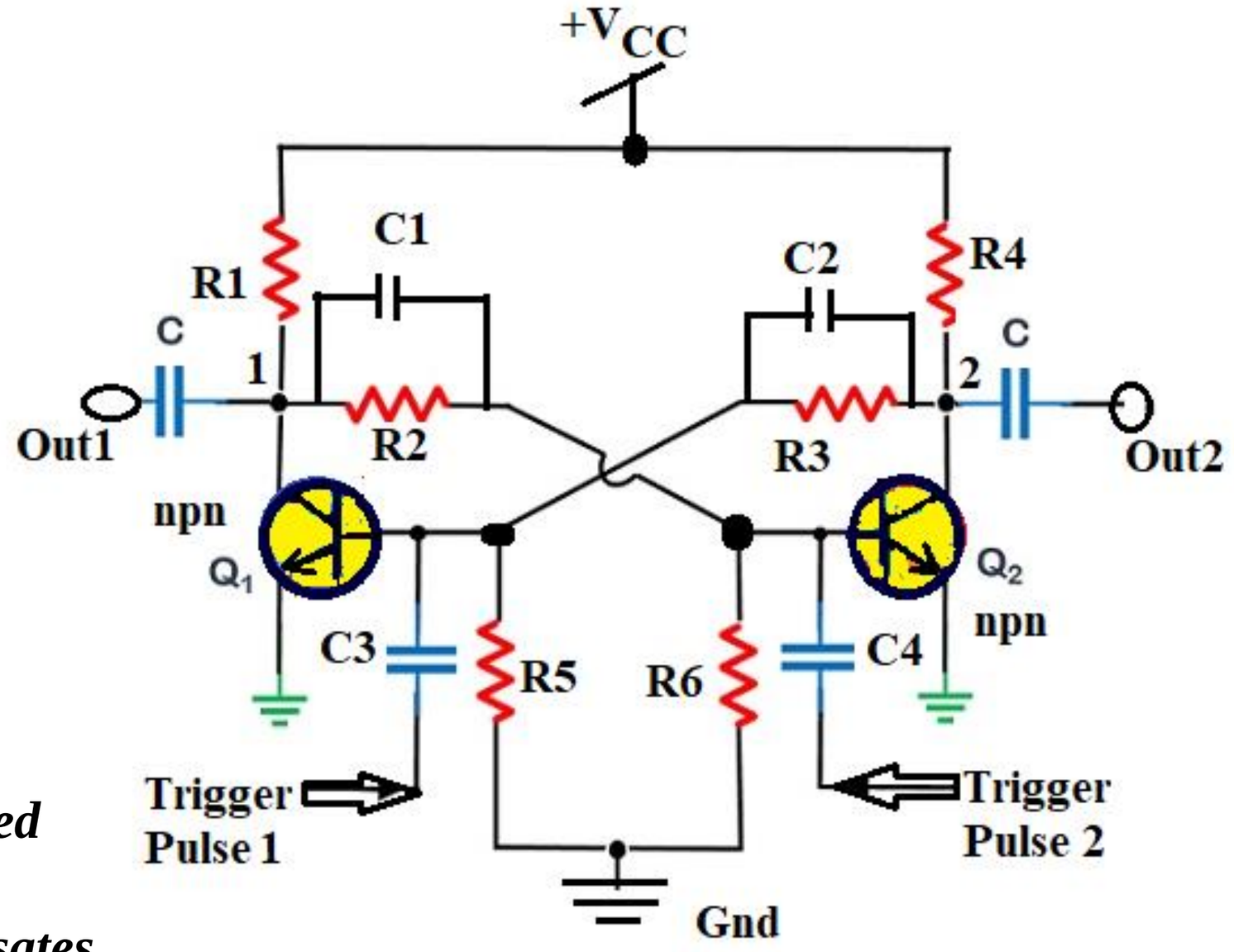

Figure 6: Operation of bistable multivibrator.

Comparison:

S.No.	Astable Multivibrator	Monostable Multivibrator	Bistable Multivibrator
1.	There are no stable states of output	There is only one stable state of output	There are two stable states of output
2.	Trigger input is not required	One trigger input is required for changing the state of output	Two trigger inputs are required for changing the state of output
3.	Used as rectangular, square wave or ramp generator	Used as timer	Used as flip flop
4.	Number of quasi stable state is two	Number of quasi stable state is one	No quasi stable state

Thank You