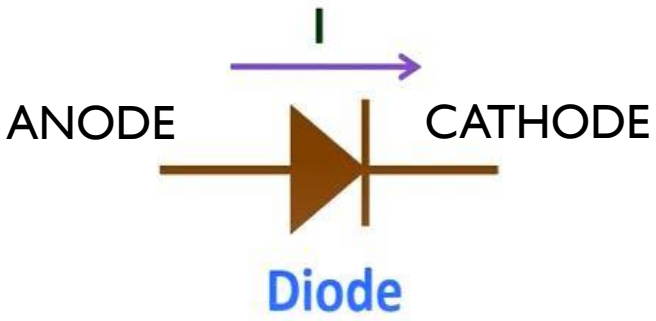
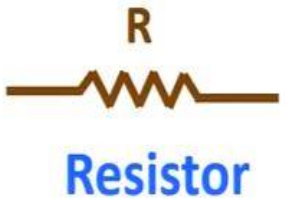
CLIPPER CIRCUIT

- The Diode Clipper, also known as a Diode Limiter, is a wave shaping circuit.
- It takes an input waveform and clips or cuts off its top half, bottom half or both halves together to produce an output waveform.
- The clipper circuit prevents the output waveform from exceeding the certain level and the same time it does not distort the remaining part of the waveform.
- Used in overvoltage protection circuit to prevent the circuits from high voltage spikes.

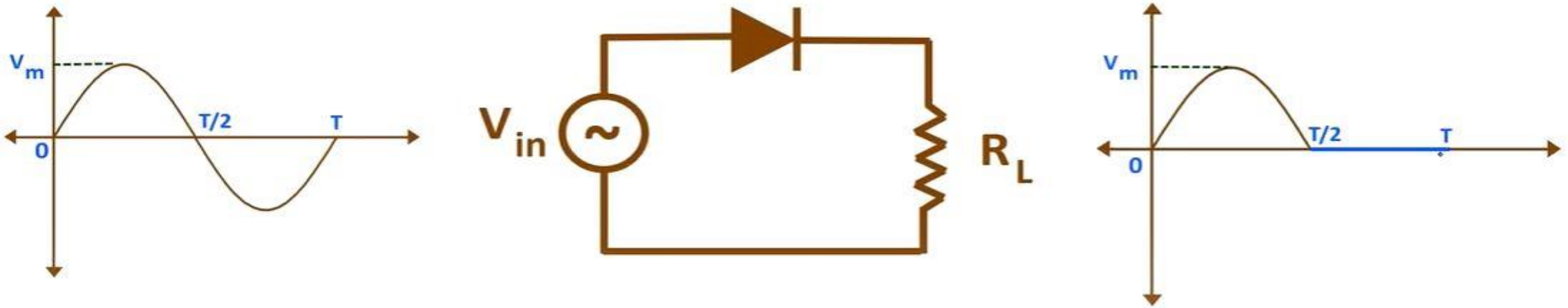




- IF ANODE IS **+VE** W.R.T CATHODE DIODE IS **FORWARD BIASED**
- IF ANODE IS **–VE** W.R.T CATHODE DIODE IS **REVERSE BIASED**

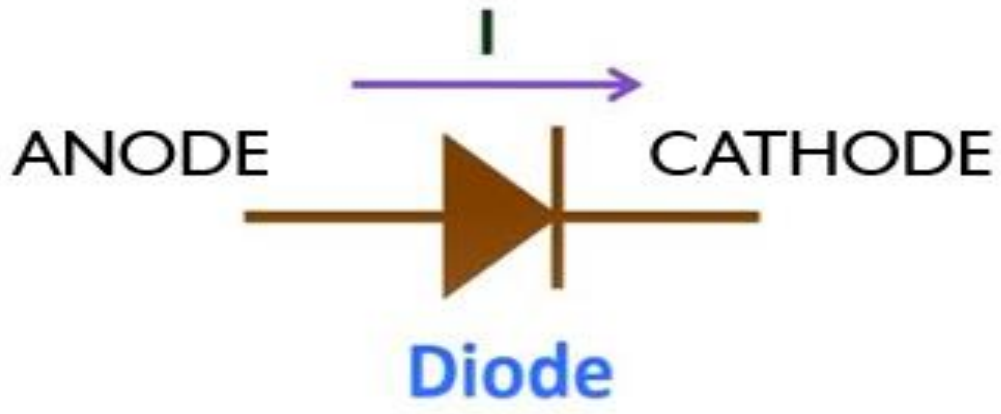
CLIPPER CIRCUIT

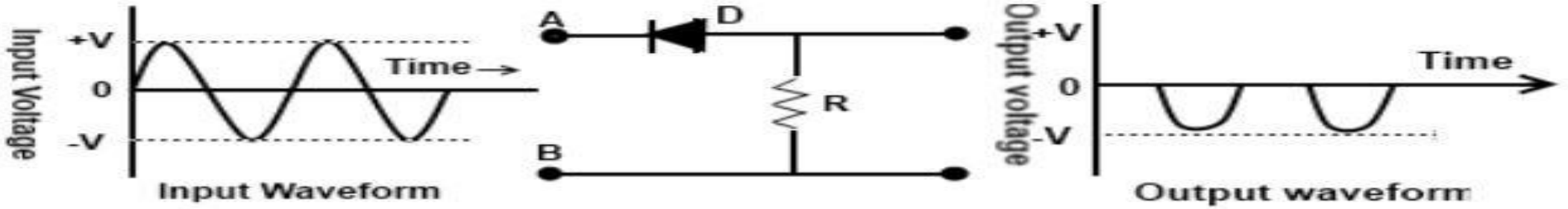
Half Wave Rectifier



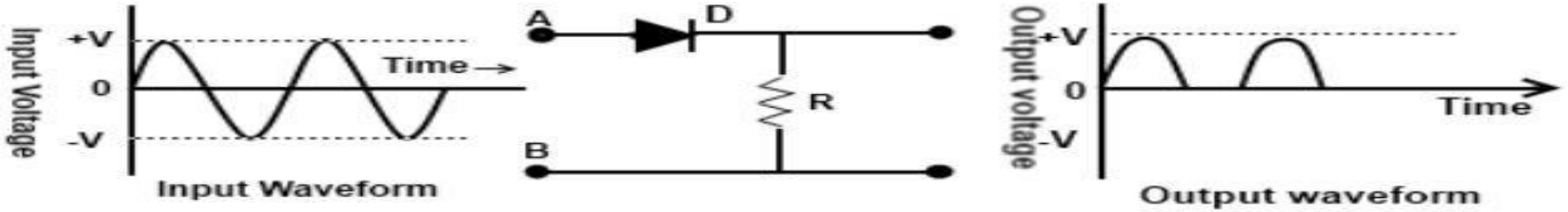
CLIPPER CIRCUIT

- When diode is forward biased, circuit acts as a **Closed switch** (ON state).
- When diode is reverse biased, it acts as a **Open switch** (OFF state).



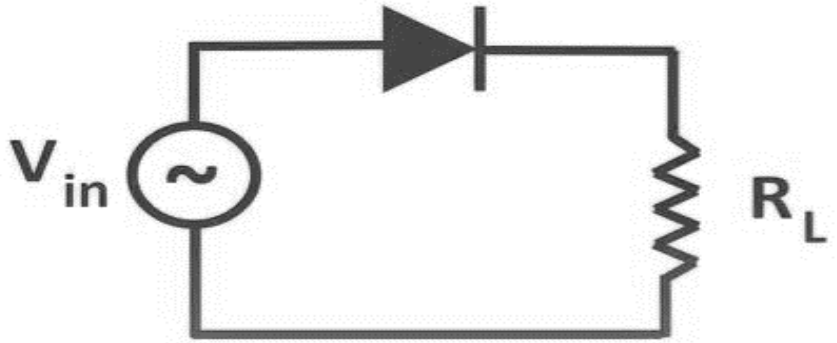


Positive clipper

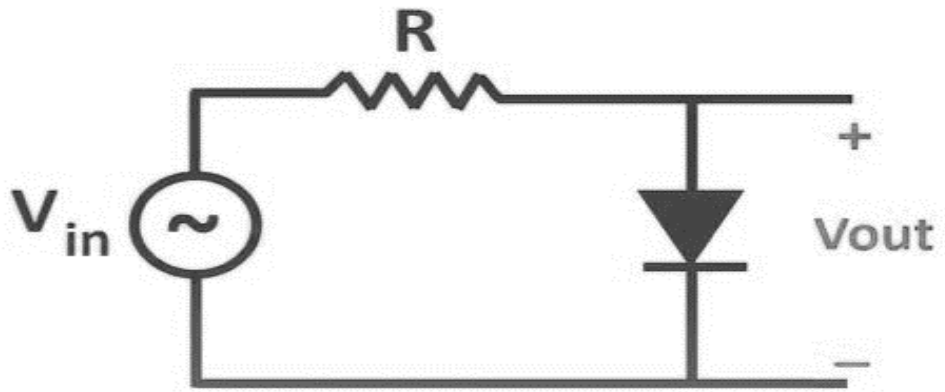


Negative clipper

Series Clipper Circuit



Parallel Clipper Circuit

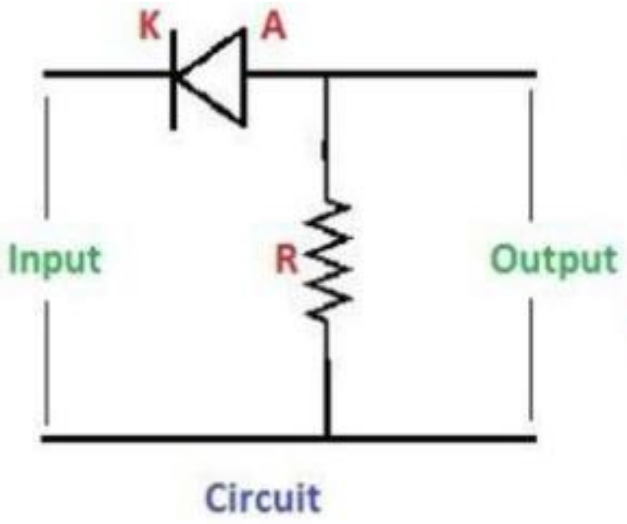


CLASSIFICATION OF CLIPPER CIRCUITS

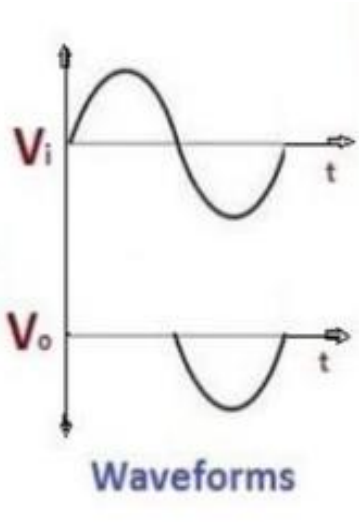
- SERIES POSITIVE CLIPPER
- SHUNT POSITIVE CLIPPER
- SERIES NEGATIVE CLIPPER
- SHUNT NEGATIVE CLIPPER
- BIASED POSITIVE CLIPPER
- BIASED NEGATIVE CLIPPER
- COMBINATIONAL CLIPPER

SERIES POSITIVE CLIPPER

- In Series Positive Clipper, A diode is connected in series with the output.
- During the positive half cycle, diode becomes reverse biased, and no output is generated across the resistor.
- During the negative half cycle, the diode conducts and the entire input appears as output across the resistor.
- It clips the positive half cycle of the input waveform, and therefore, it is called as a series positive clipper.



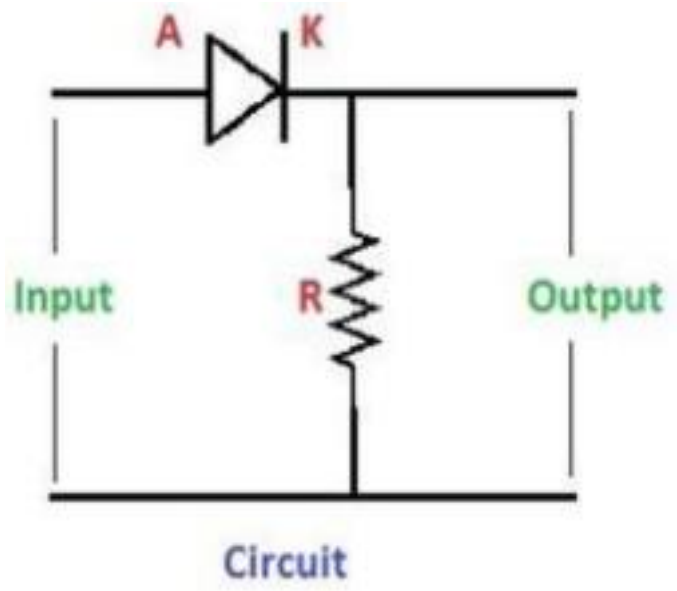
Circuit

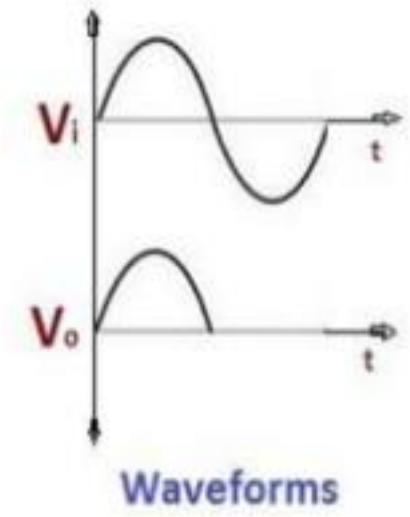


Waveforms

SERIES NEGATIVE CLIPPER

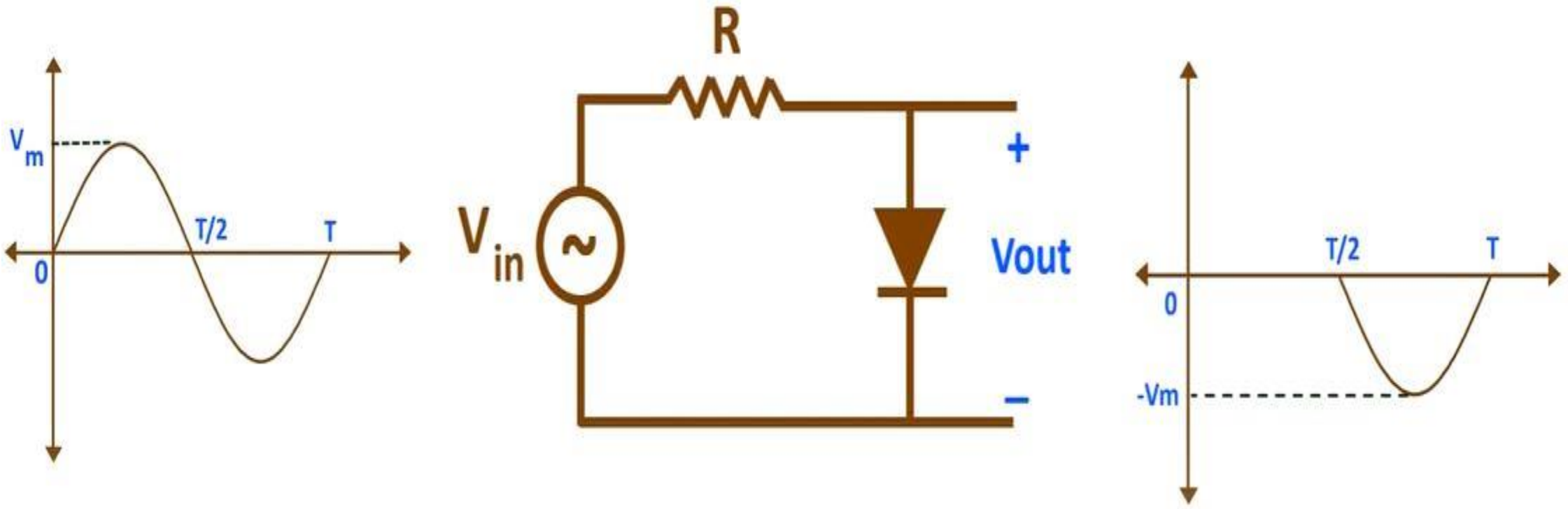
- In Series Negative Clipper, A diode is connected in series with the output.
- During the positive half cycle, the diode appears in the forward biased and conducts such that the entire positive half cycle of input appears across the output.
- During the negative half cycle the diode is in reverse biased. No output appears across the resistor.
- It clips the negative half cycle of the input waveform, and therefore, it is called as a series negative clipper.





SHUNT POSITIVE CLIPPER

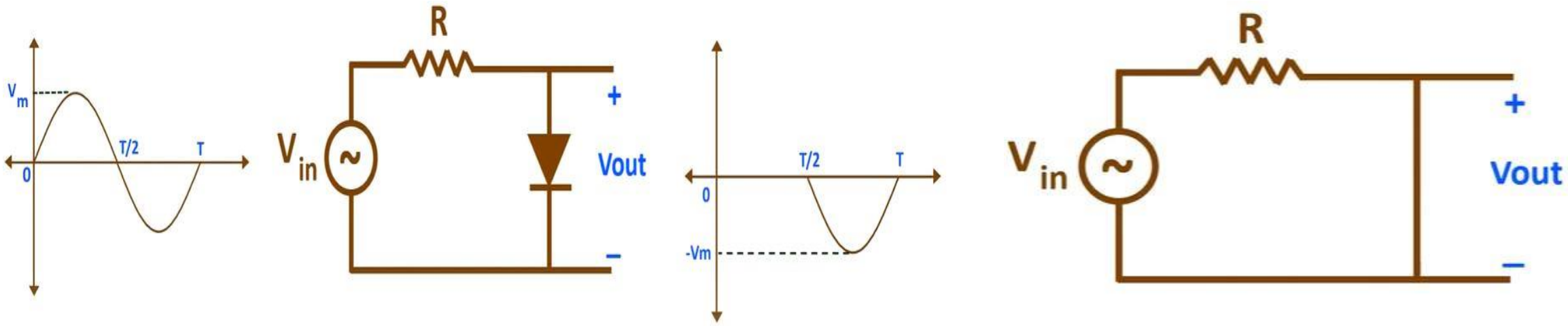
- A Positive Clipper Circuit, in which output taken across the diode connected parallel to Output.



In Shunt cases:
Diode – FB – o/p (0V or Battery Voltage)
Diode – RB – o/p (Input)

SHUNT POSITIVE CLIPPER

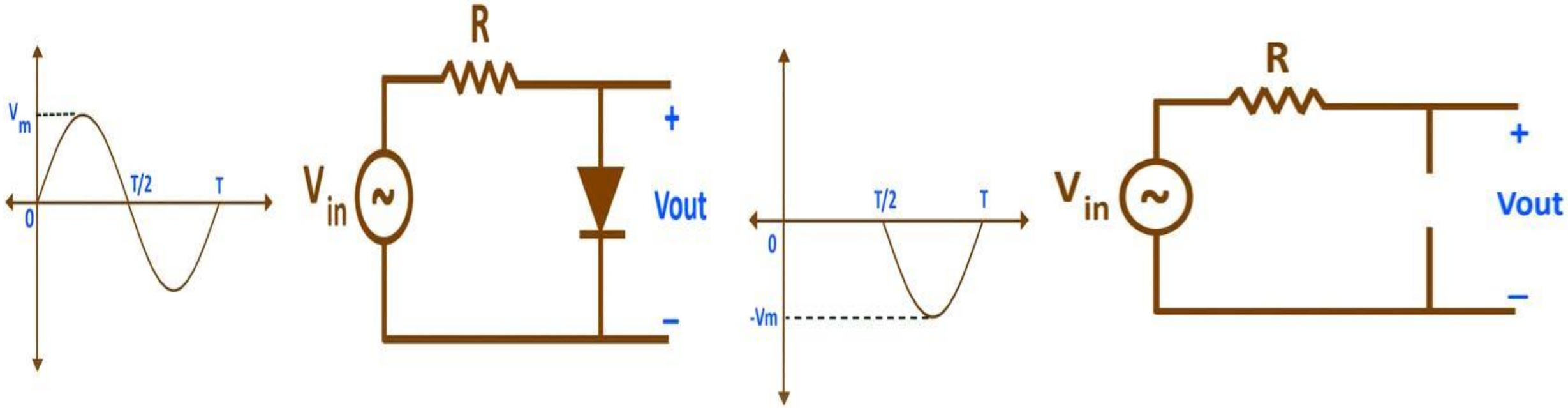
- In Positive Half Cycle the diode is forward biased (anode more positive than cathode).



- Diode act as Short Circuit and act as Closed Switch.
- So No output across output.

SHUNT POSITIVE CLIPPER

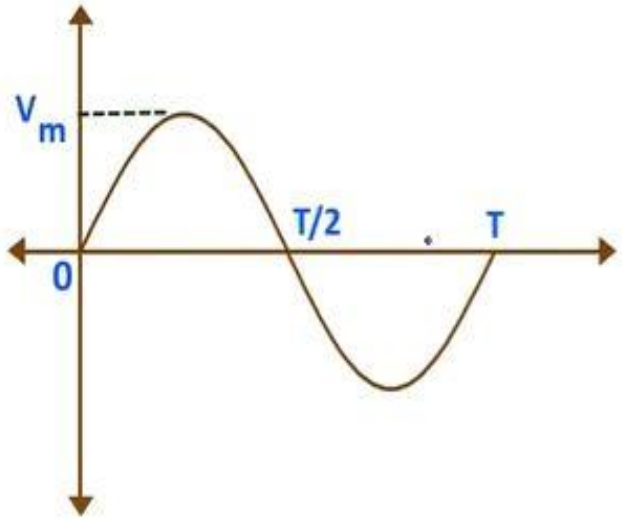
- In Negative Half Cycle the diode is Reverse biased (Cathode more positive than Anode).

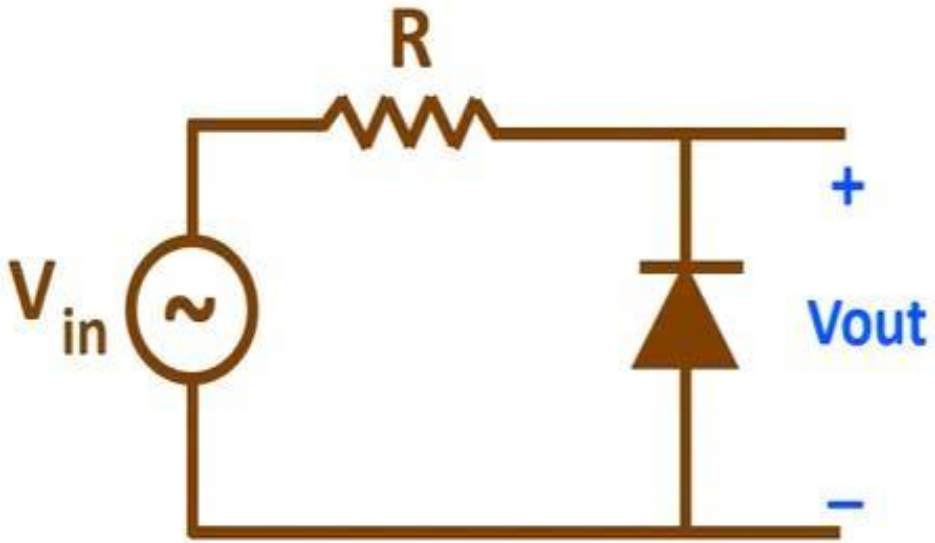


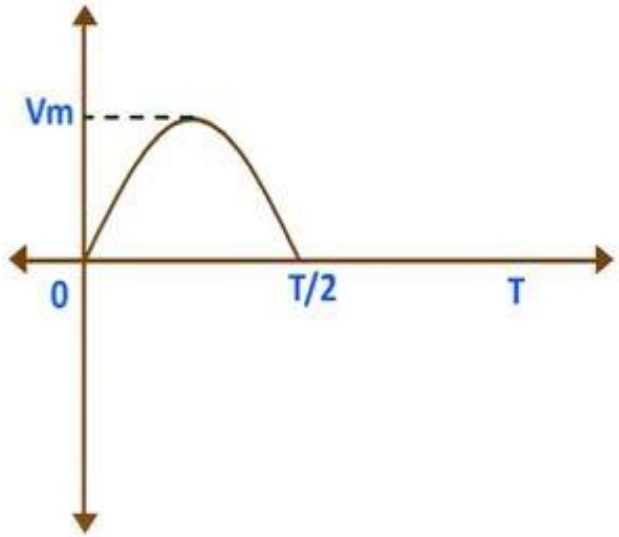
- Diode act as Open Circuit
- So all input voltage dropped across output
- In Practical Case, For the diode to become forward biased, it must have the input voltage magnitude greater than +0.7 volts (0.3 volts for a germanium diode).

SHUNT NEGATIVE CLIPPER

- A Negative Clipper Circuit, in which output taken across the diode connected parallel to Output.



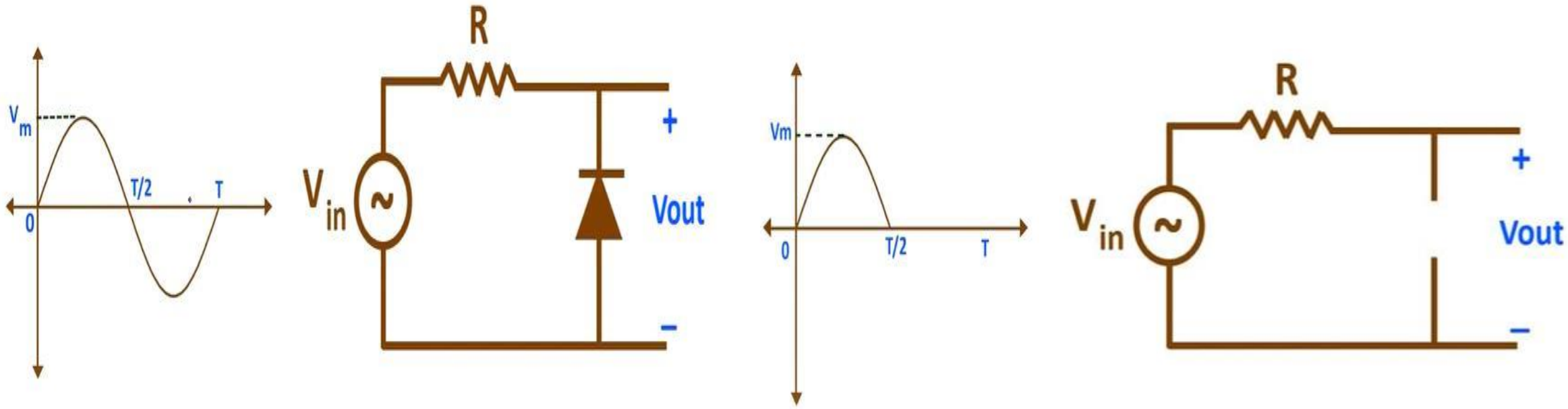




In Shunt cases:
Diode – FB – o/p (0V or Battery Voltage)
Diode – RB – o/p (Input)

SHUNT NEGATIVE CLIPPER

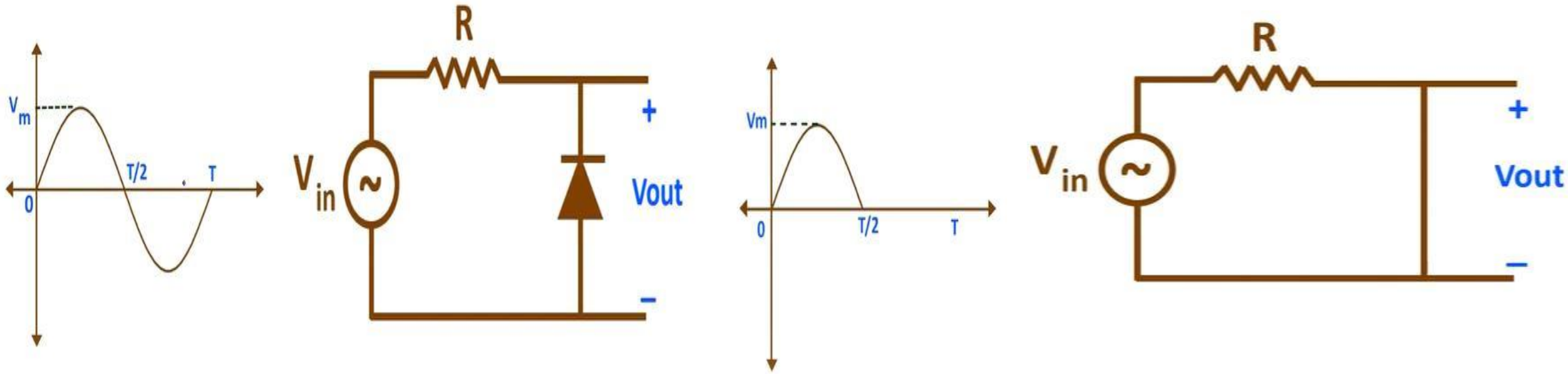
- In Positive Half Cycle the diode is Reverse biased (anode more positive than cathode) and acts as Open Switch.



- Diode act as Open Switch.
- So all input voltage dropped across output

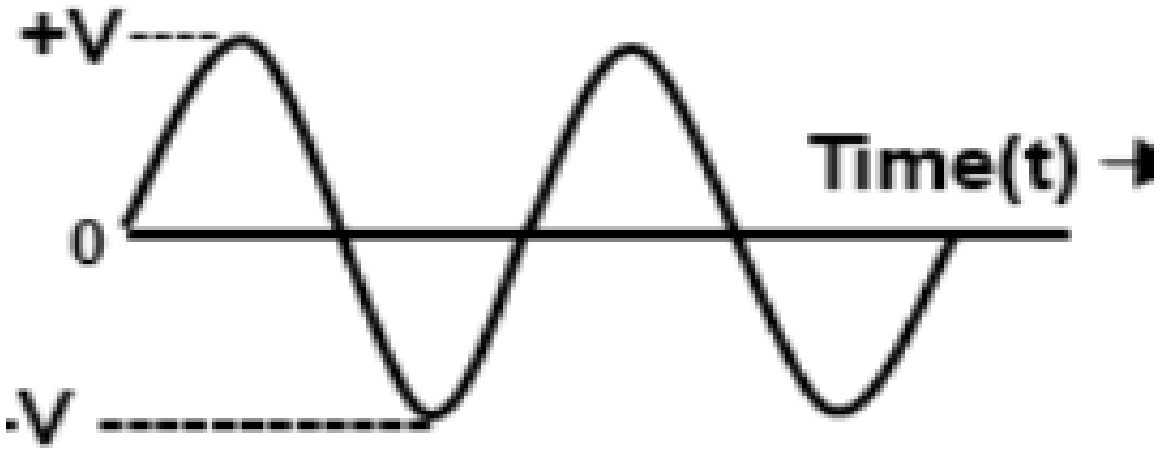
SHUNT NEGATIVE CLIPPER

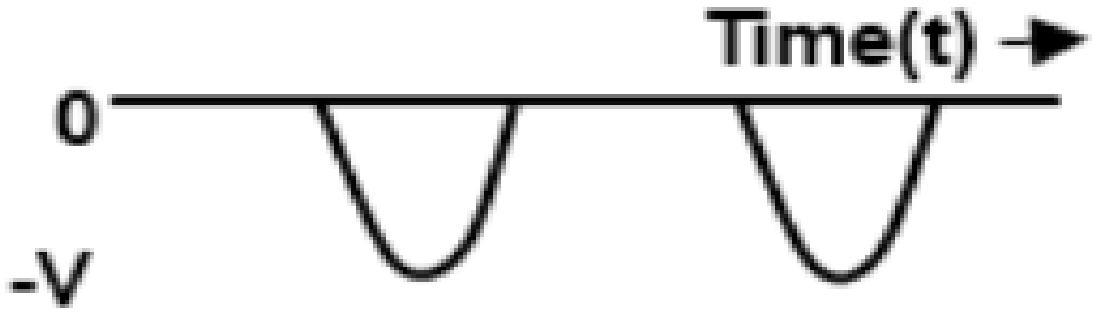
- In Negative Half Cycle the diode is forward biased (anode more positive than cathode).

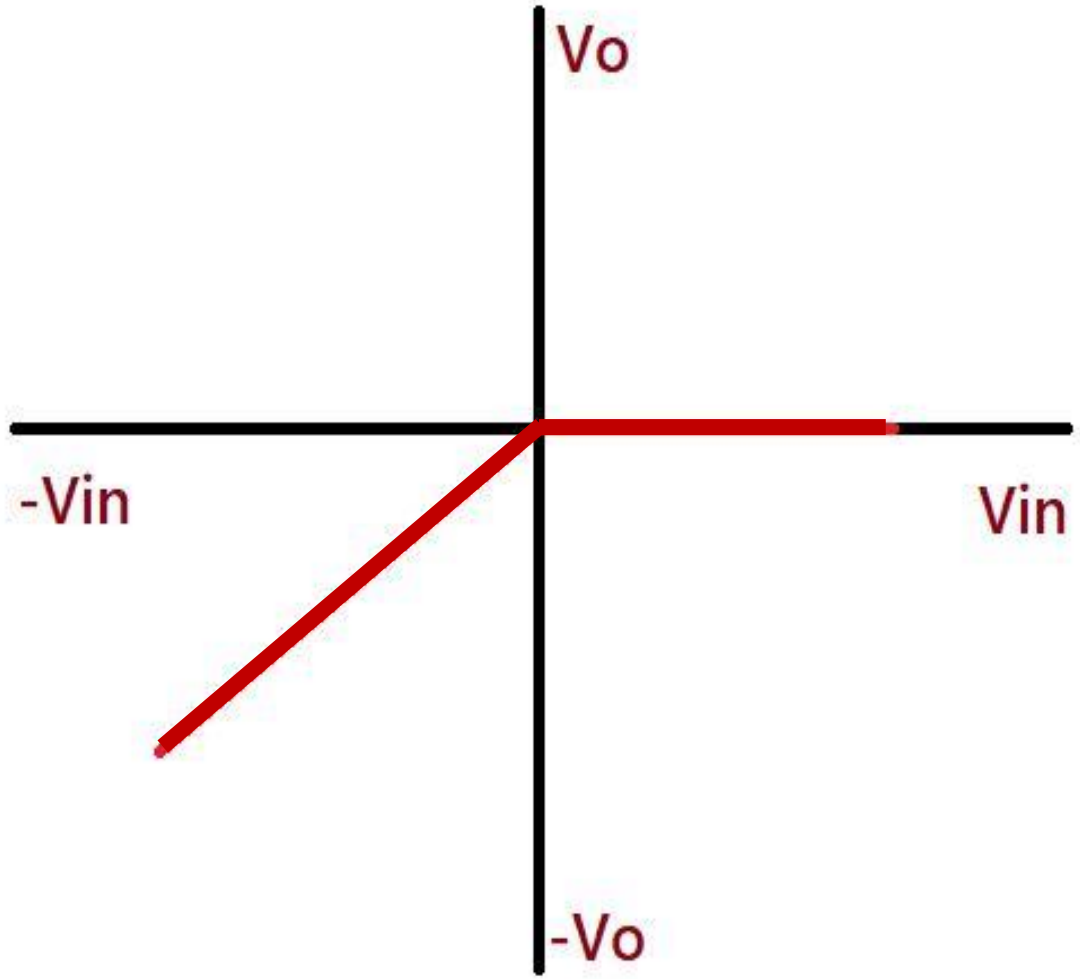


- Diode act as Short Circuit and act as Closed Switch.
- So No output across output.
- In Practical Case, For the diode to become forward biased, it must have the input voltage magnitude greater than +0.7 volts (0.3 volts for a germanium diode).

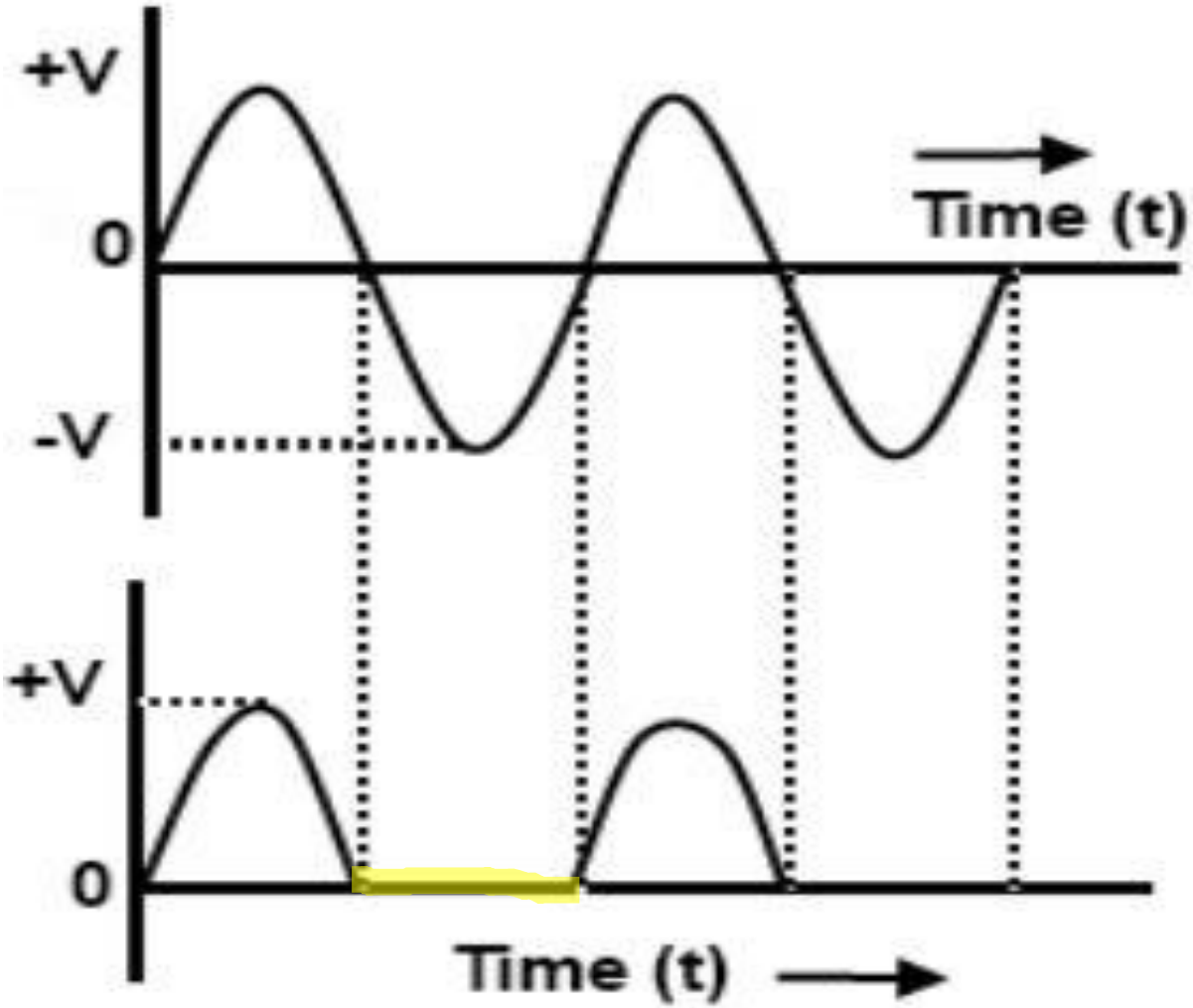
TRANSFER CHARACTERISTICS POSITIVE CLIPPER

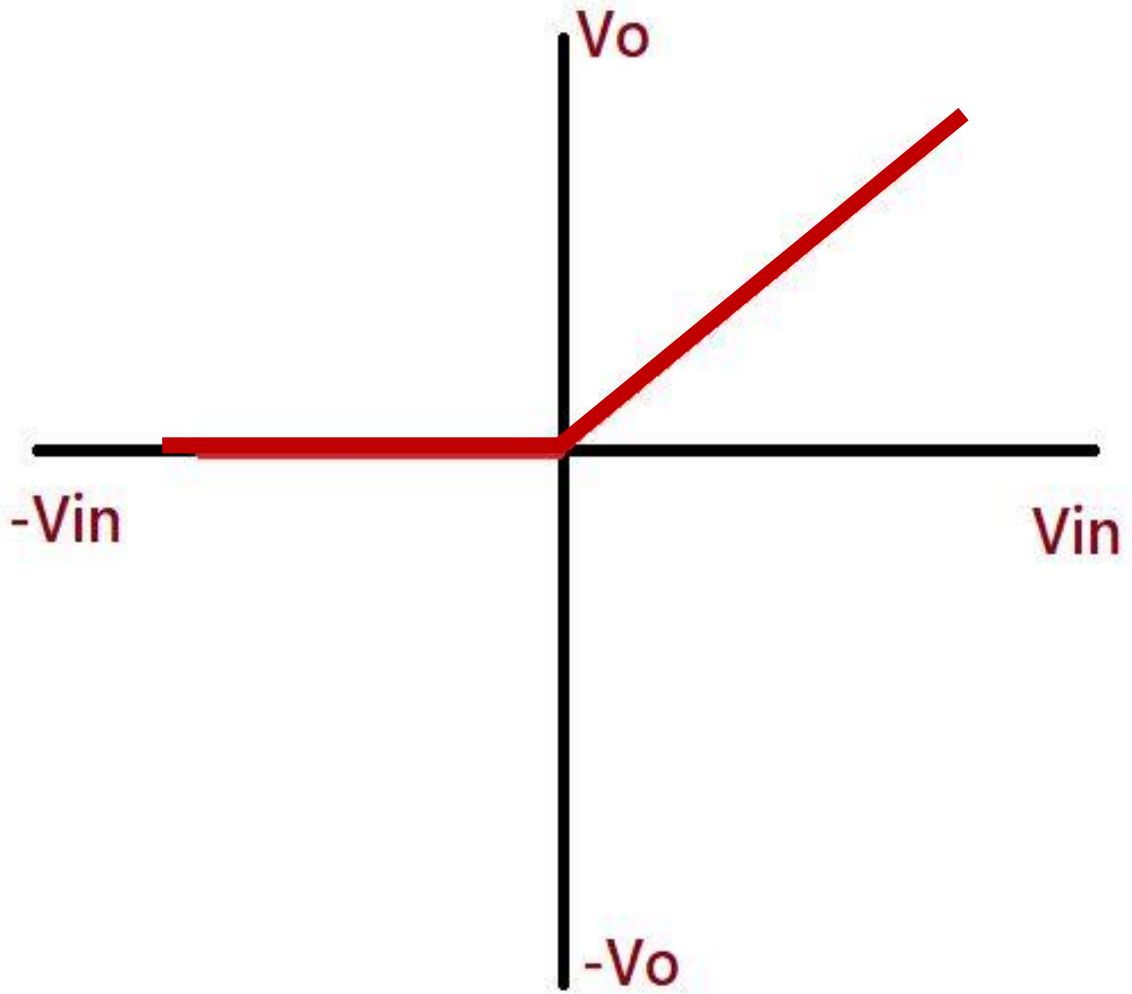






TRANSFER CHARACTERISTICS NEGATIVE CLIPPER



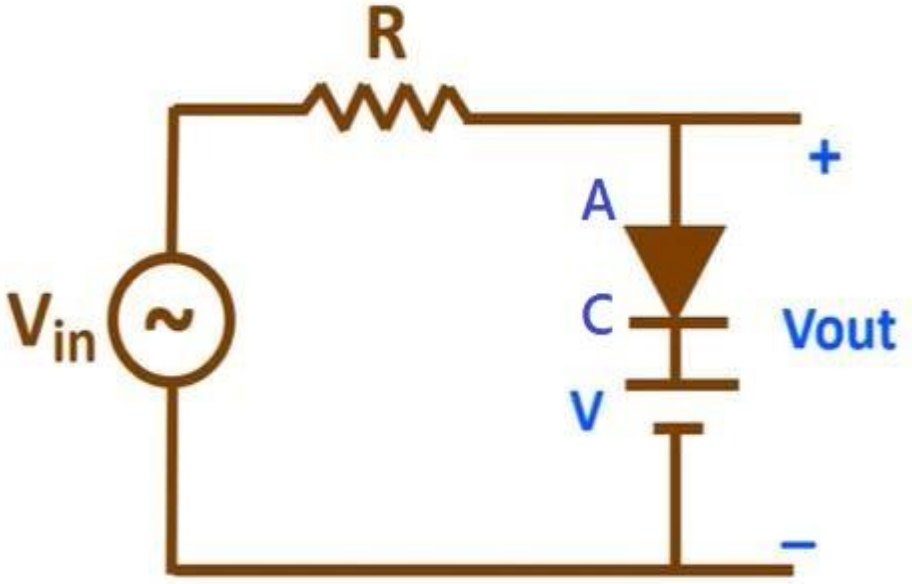


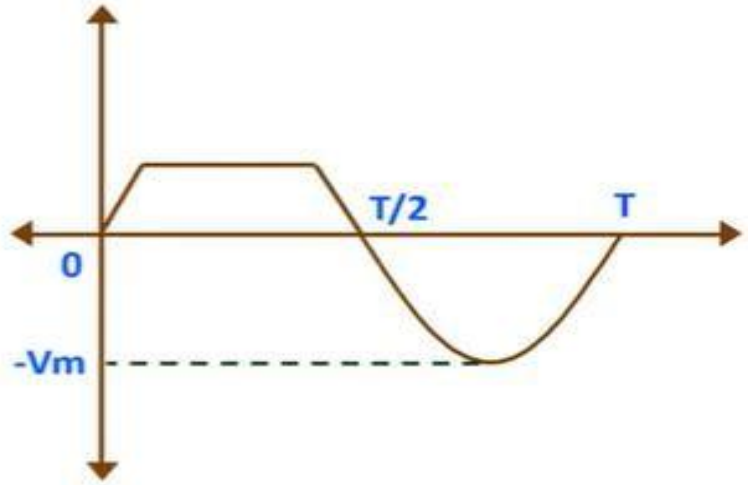
BIASED CLIPPERS

- A biased clipper comes in use when a small portion of positive or negative half cycles of the signal voltage is to be removed.
- In these clippers along with Diode and Resistor, a Battery is used.
- They are divided into
  - Positive Clipper – Positive Biased
  - Positive Clipper – Negative Biased
  - Negative Clipper – Positive Biased
  - Negative Clipper – Negative Biased

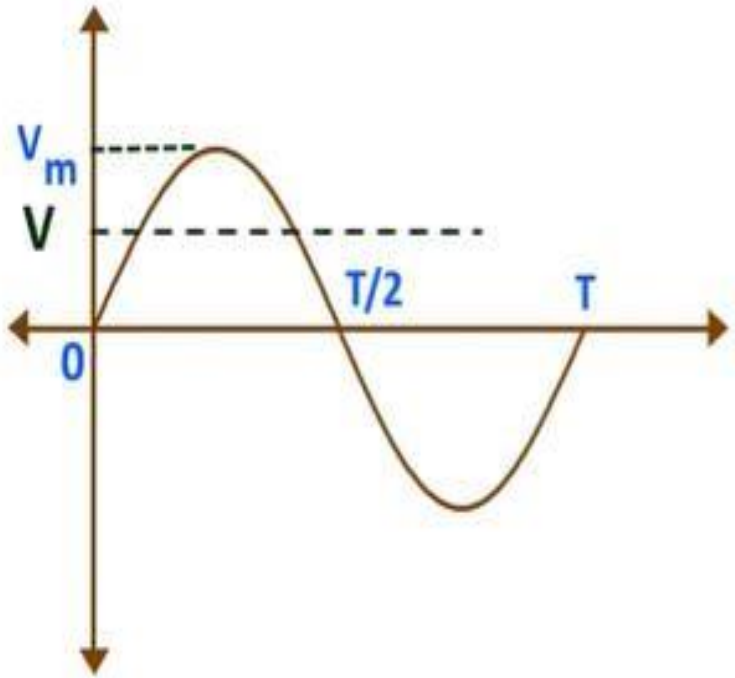
POSITIVE CLIPPER – POSITIVE BIASED

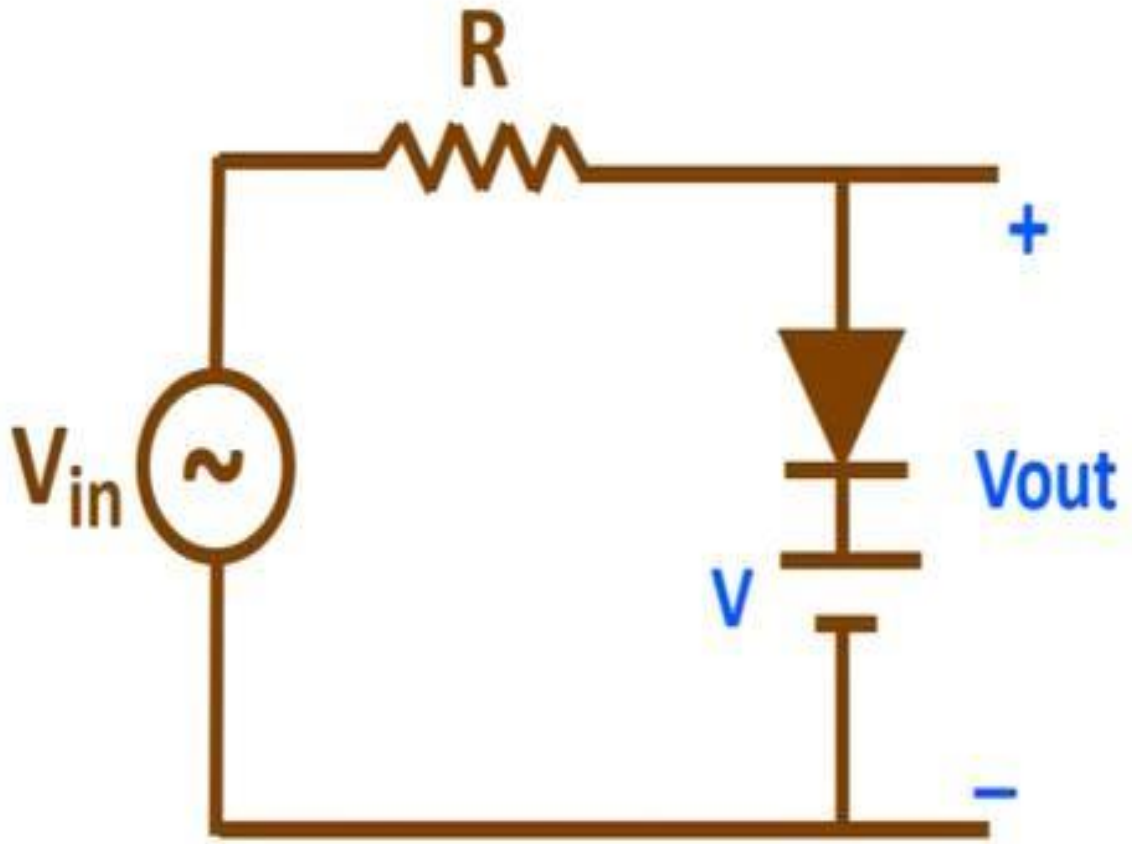
- In Biased Positive Clipper (Positive Biased), Is a Positive Clipper in which Positive terminal of the battery is connected to the cathode of the diode.
- Diode will be in **Reverse Biased** when Input signal is less than Biased Voltage (Ideal Case)
- Diode will be in **Forward Biased** when Input signal is more than Biased Voltage (Ideal Case)





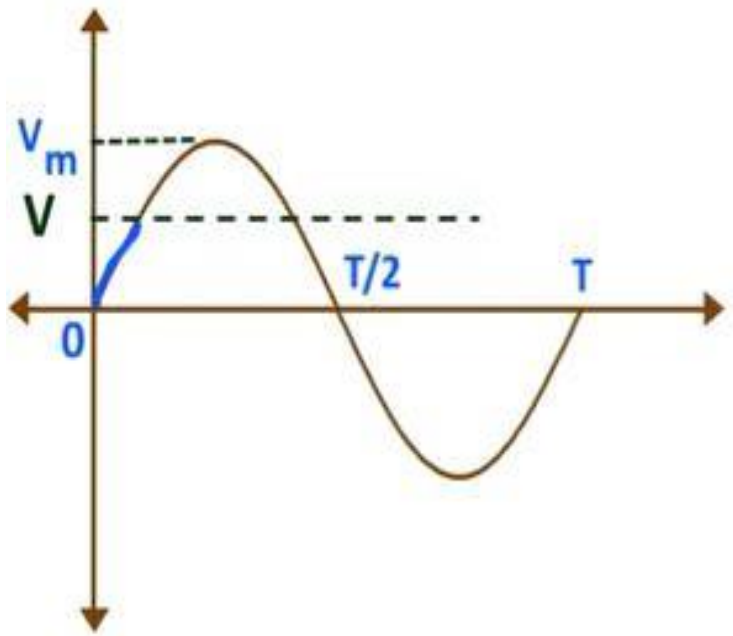
POSITIVE CLIPPER – POSITIVE BIASED

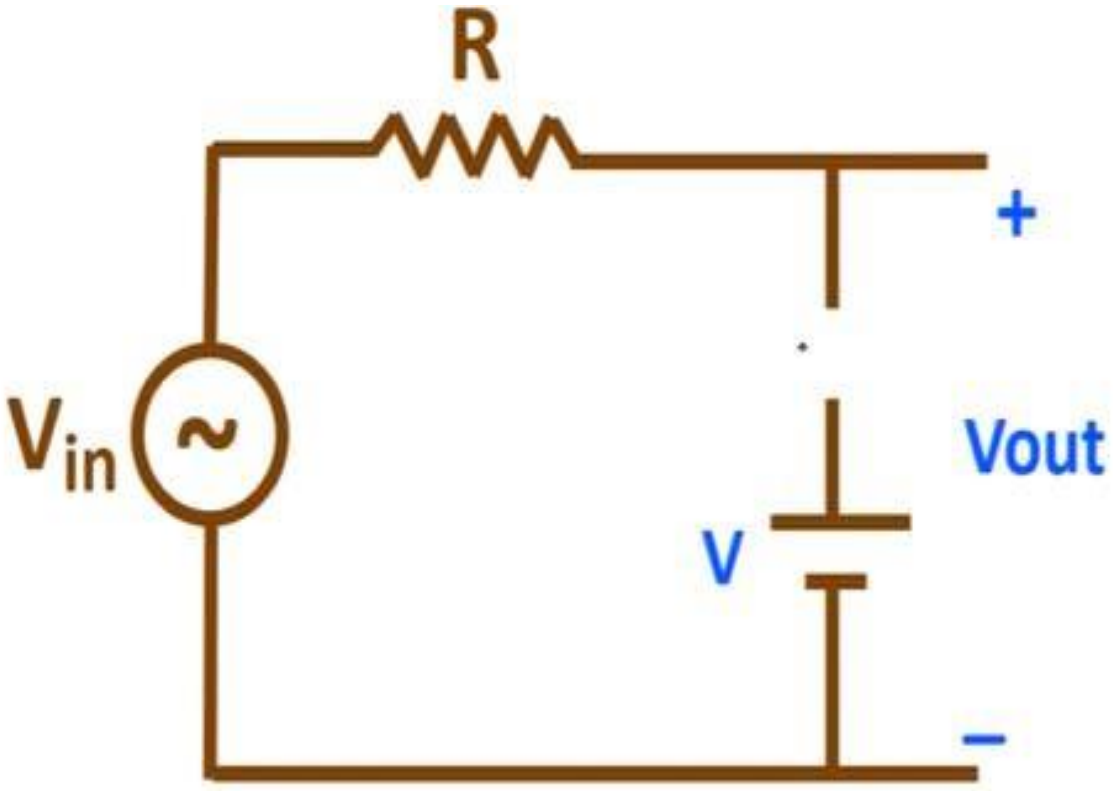




SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – POSITIVE BIASED

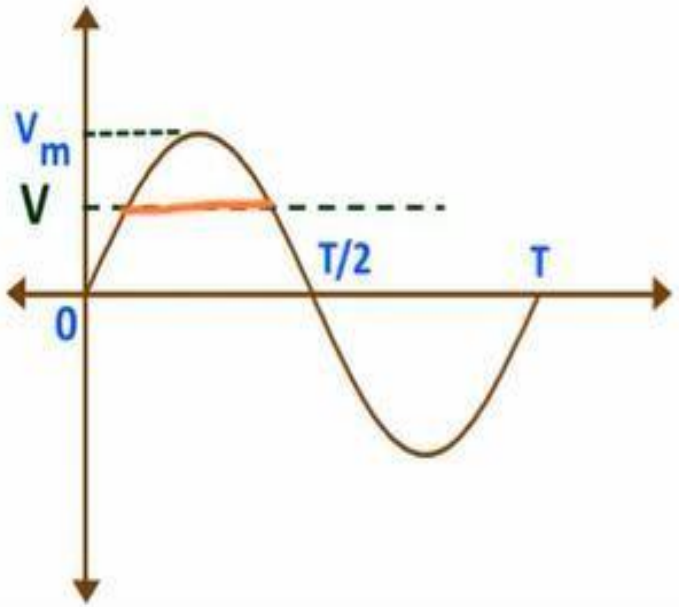


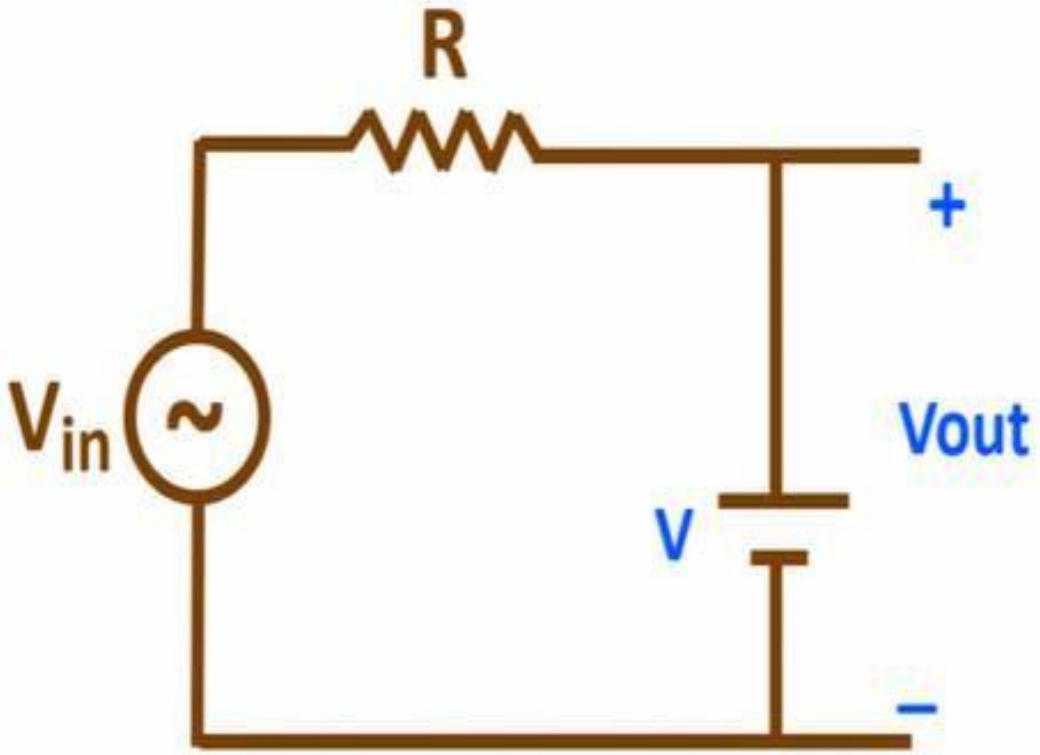


Vin < V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – POSITIVE BIASED

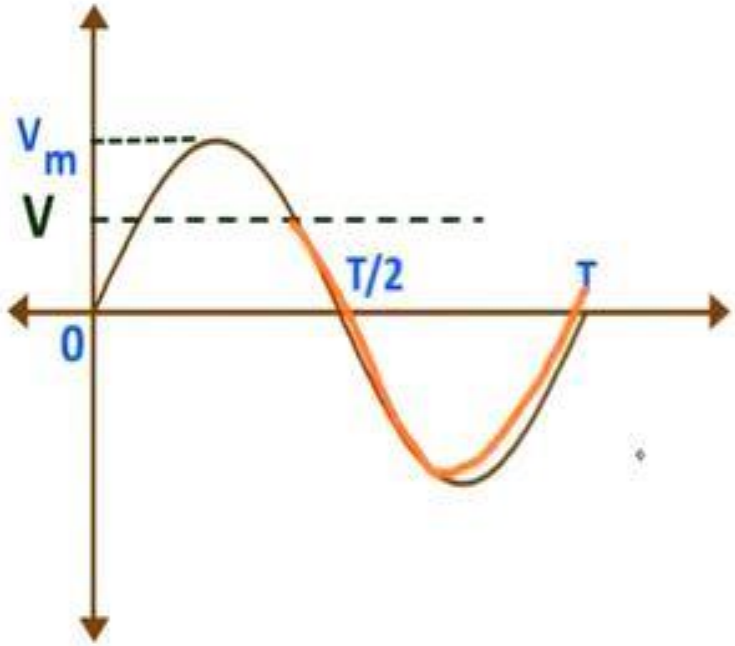


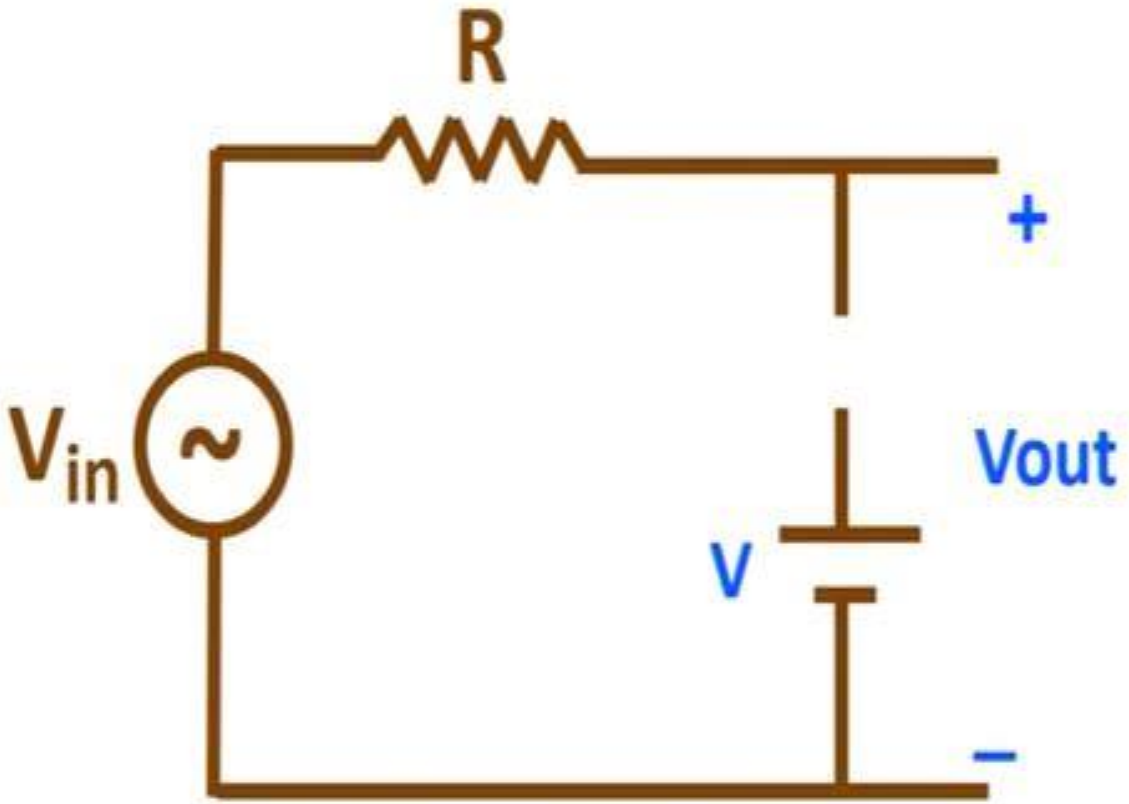


Vin > V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – POSITIVE BIASED

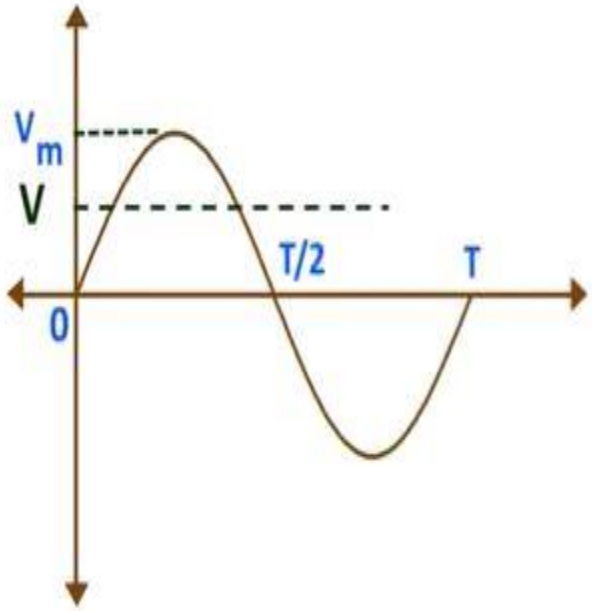


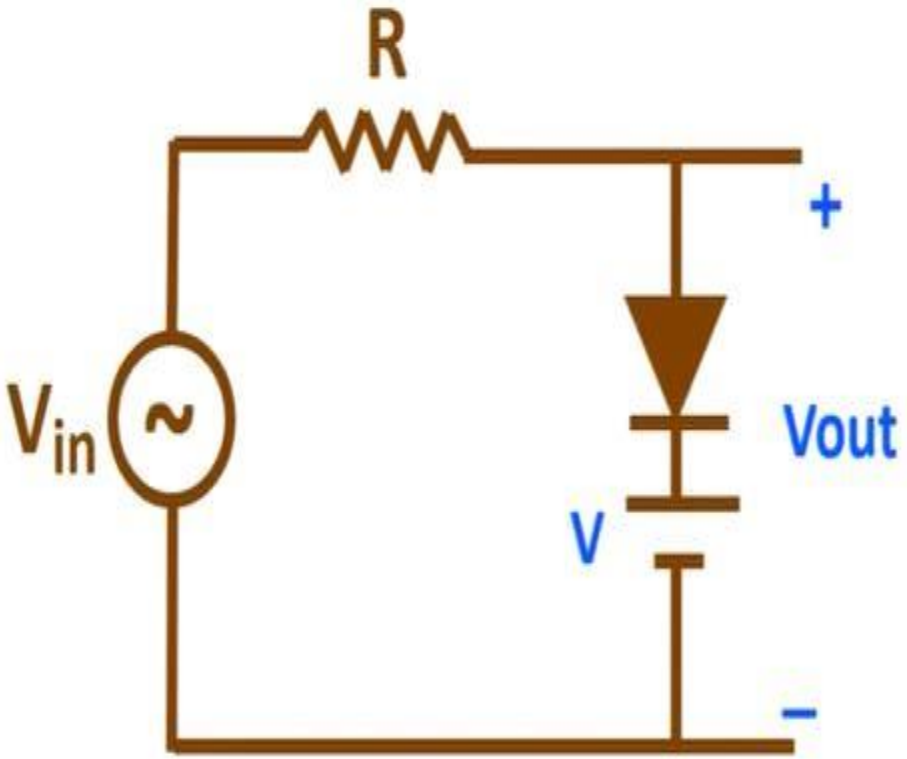


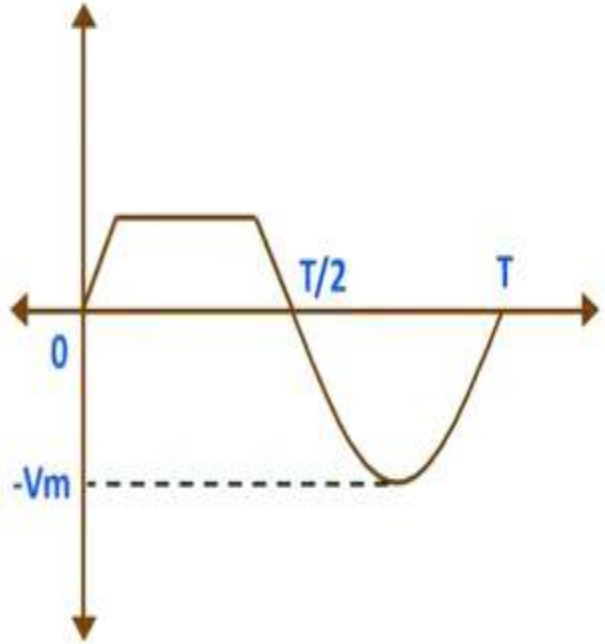
Vin < V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – POSITIVE BIASED

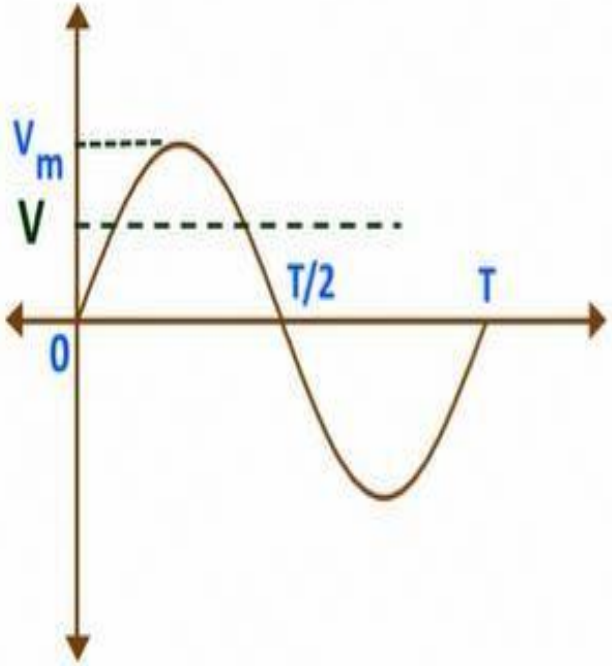


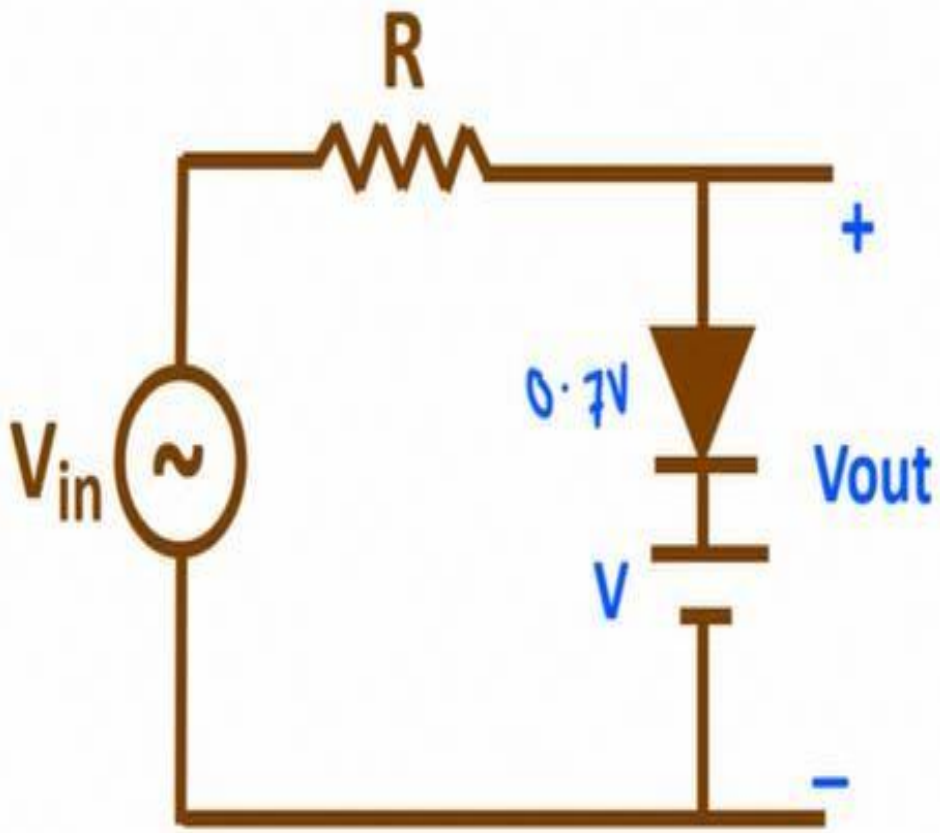


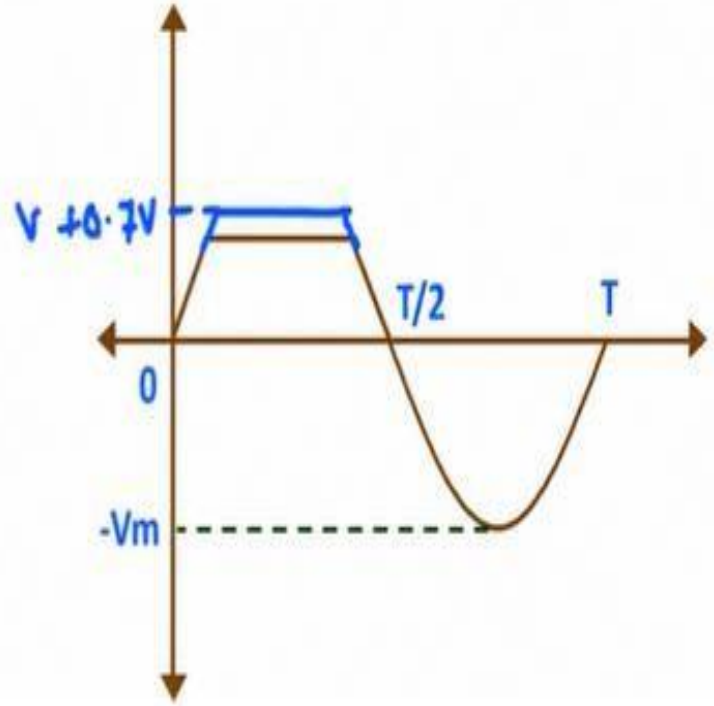


SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – POSITIVE BIASED





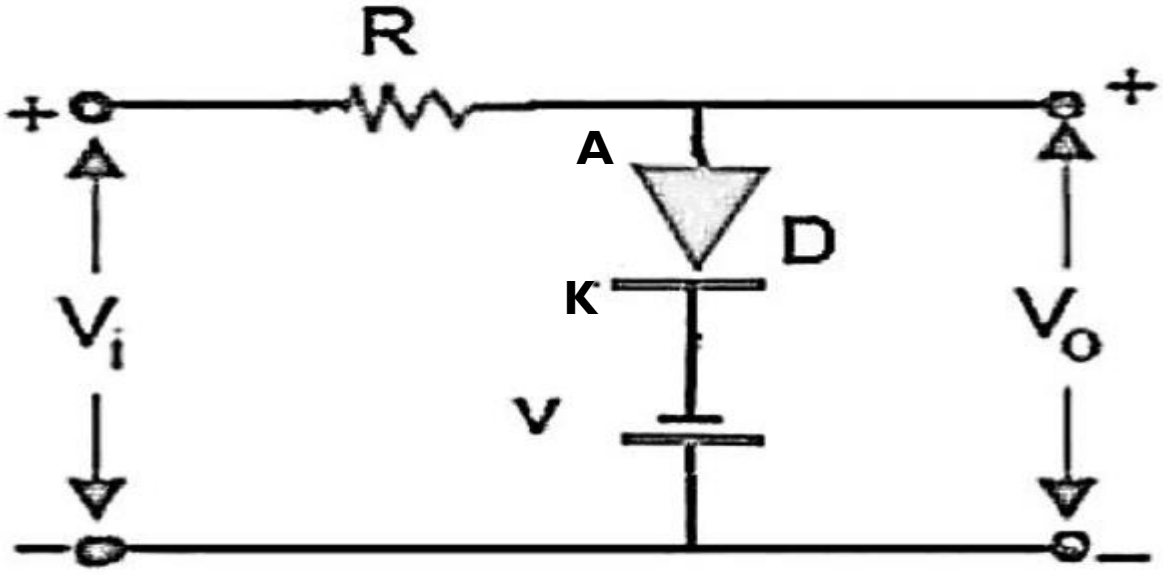


NON IDEAL CASE

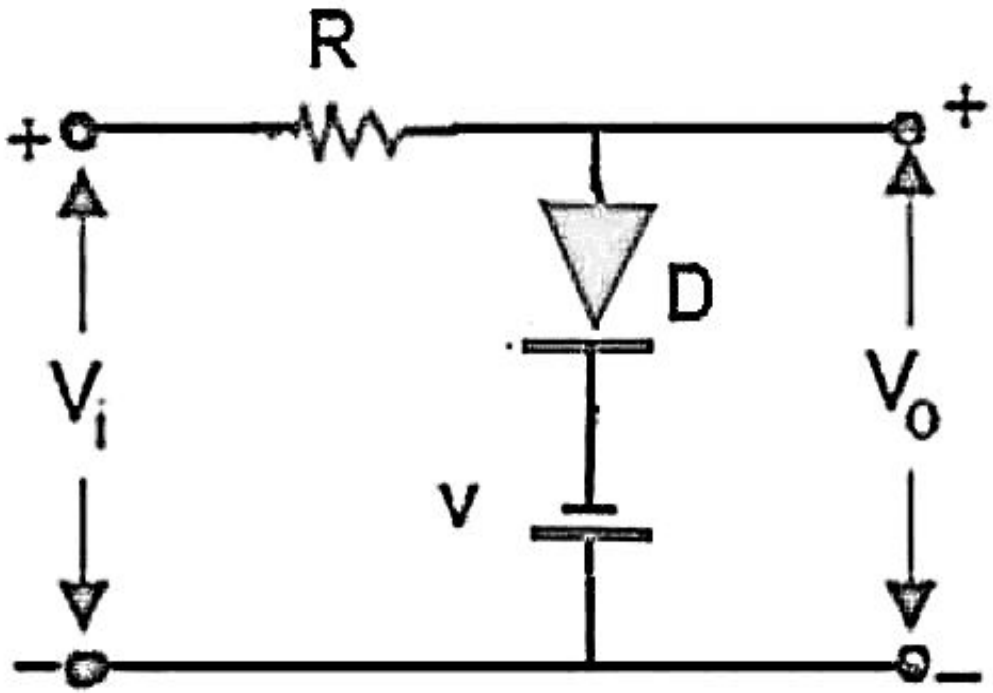
SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

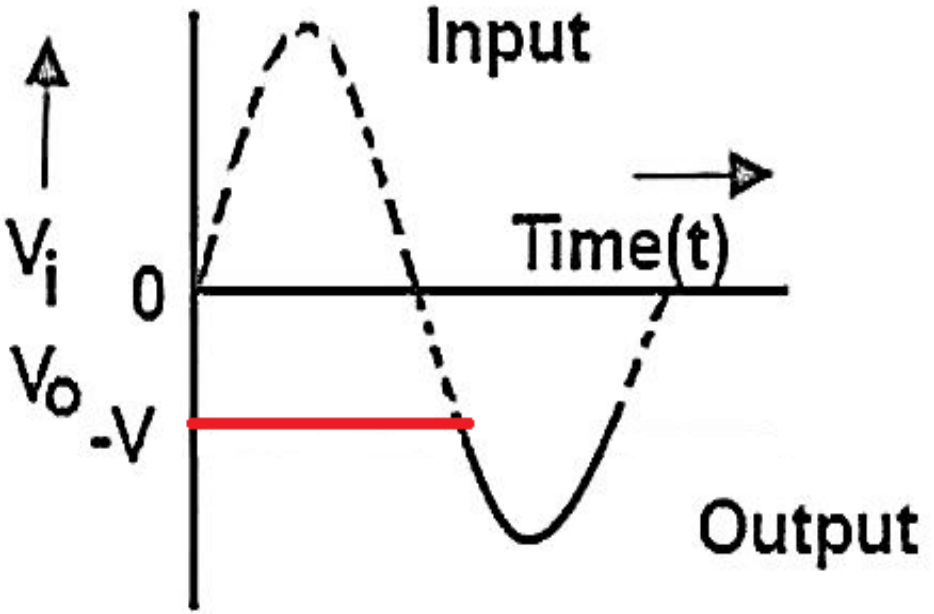
POSITIVE CLIPPER – NEGATIVE BIASED

- In Biased Positive Clipper (Negative Biased), Is a Positive Clipper in which Negative terminal of the battery is connected to the cathode of the diode.
- Input signal above –V voltage is clipped off



POSITIVE CLIPPER – NEGATIVE BIASED

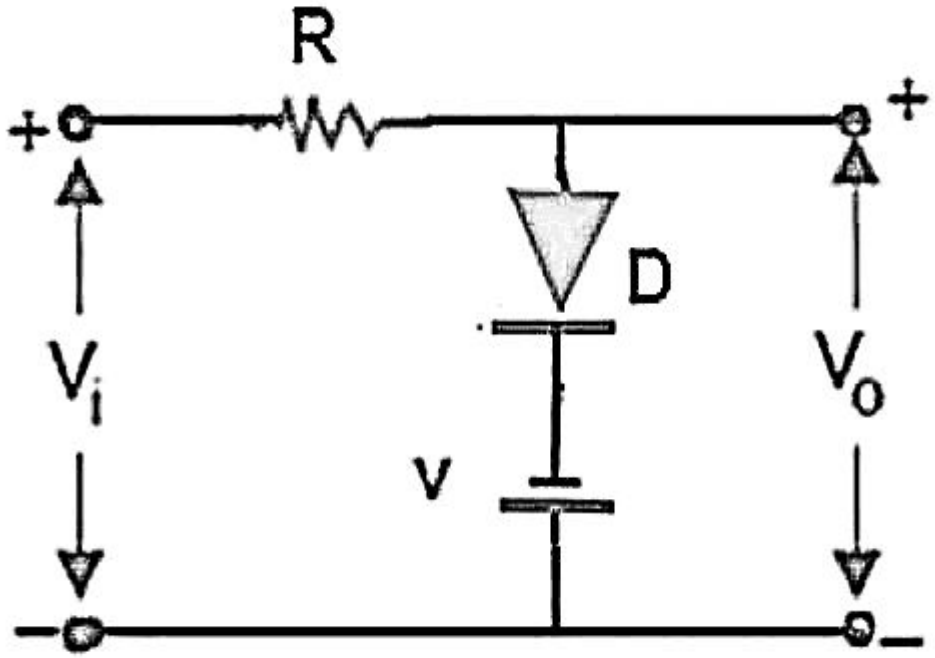


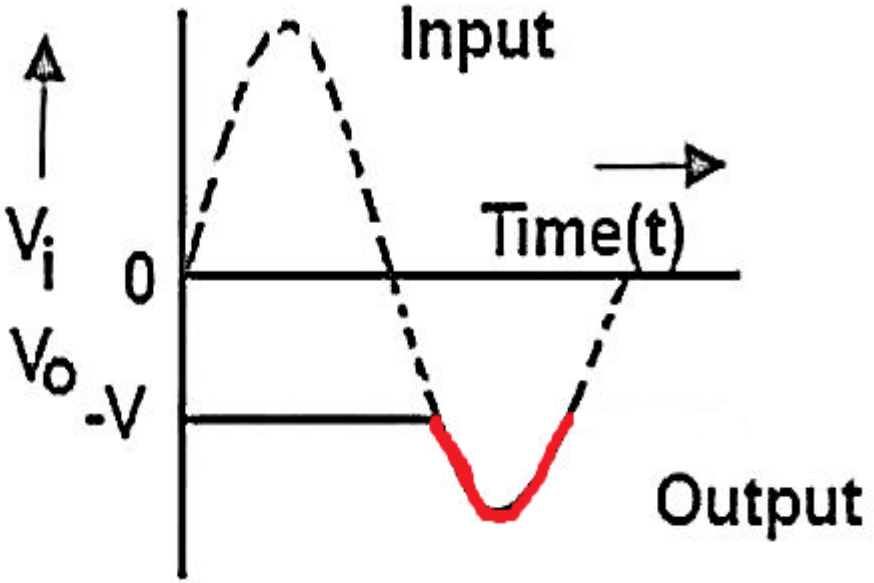


Vin > V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – NEGATIVE BIASED

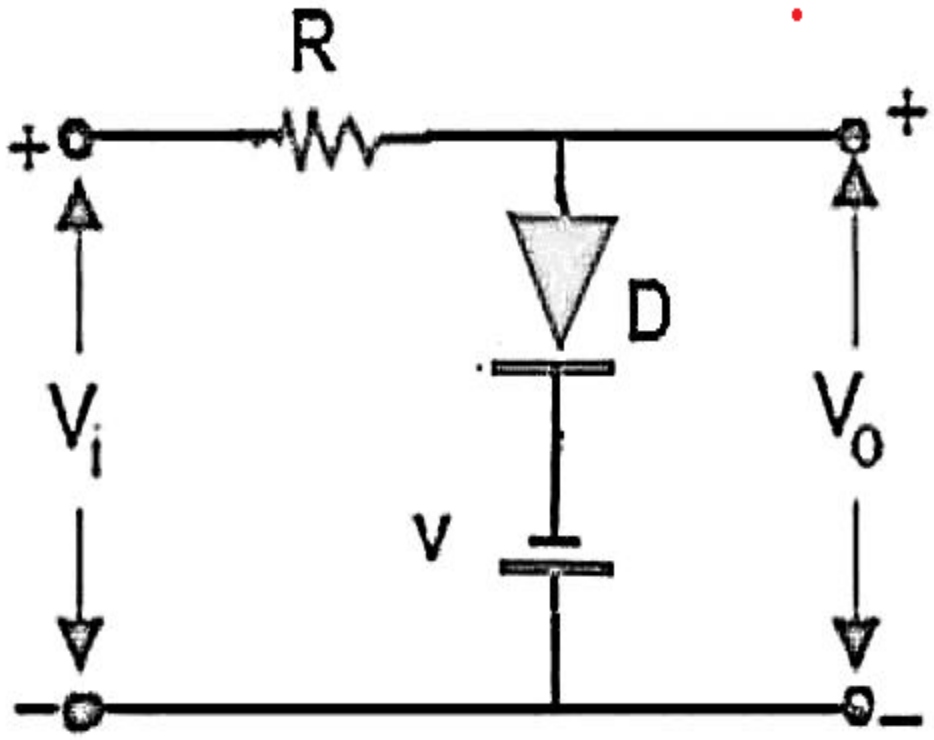


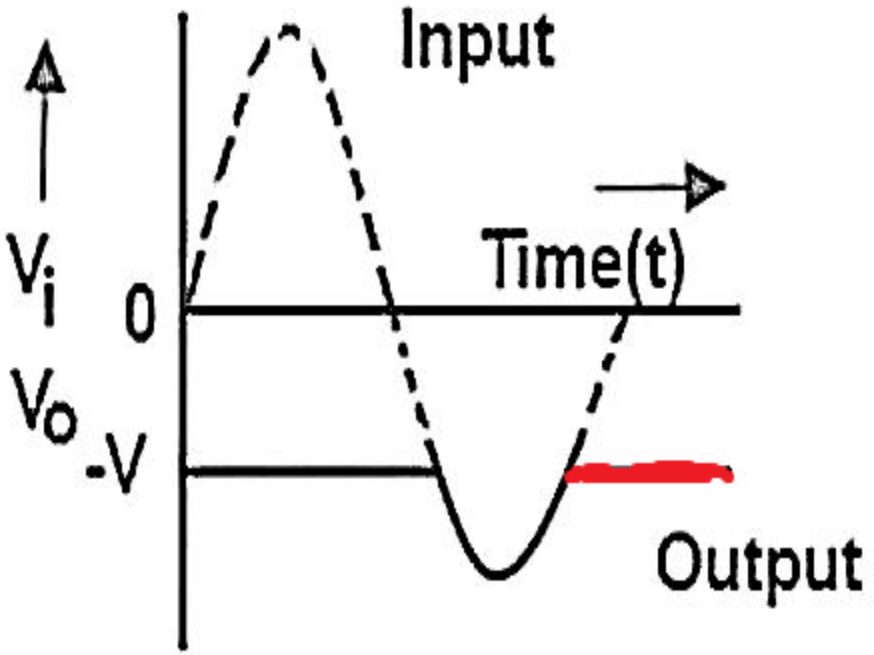


Vin < V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – NEGATIVE BIASED

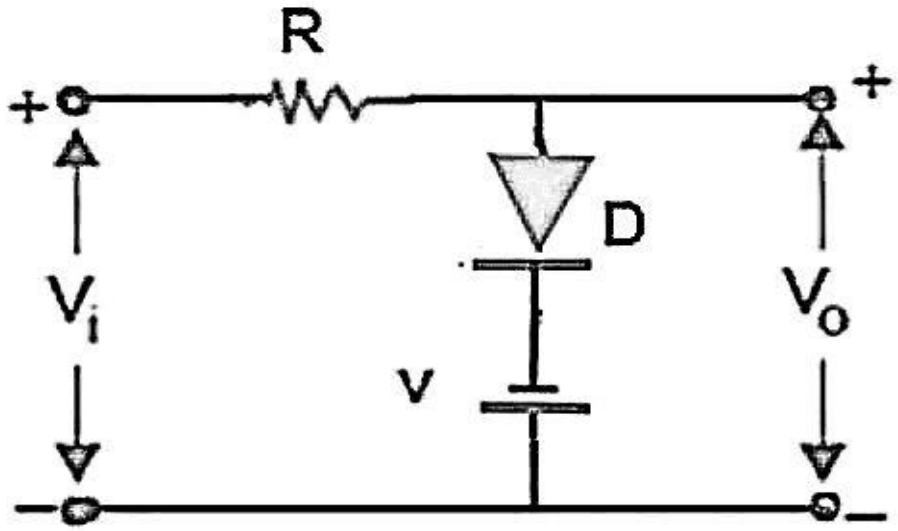


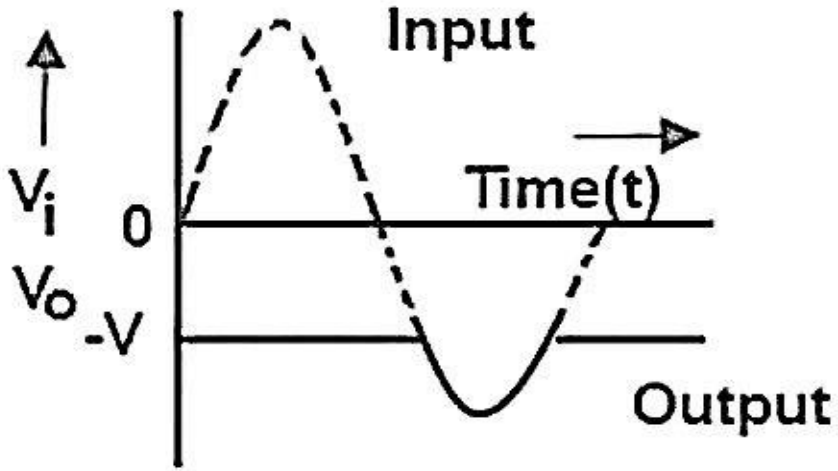


Vin > V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

POSITIVE CLIPPER – NEGATIVE BIASED

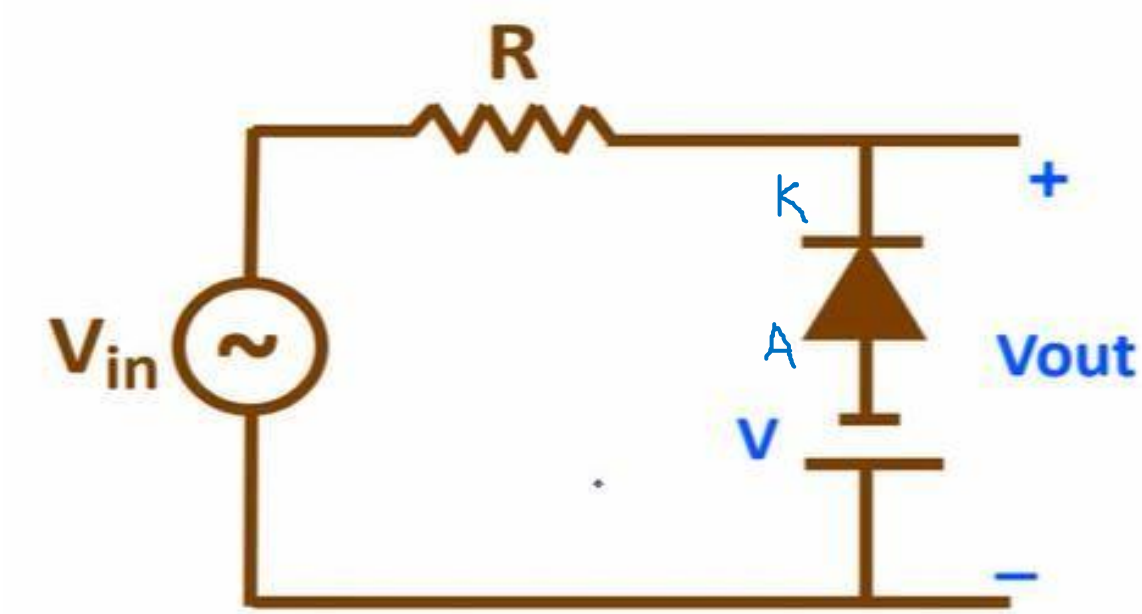


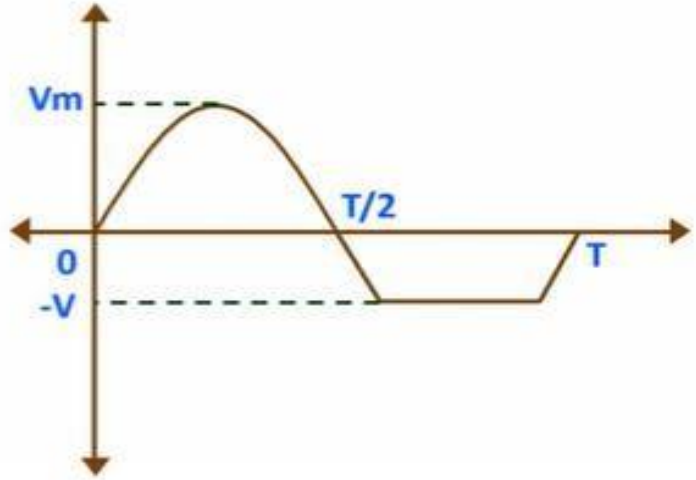


SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

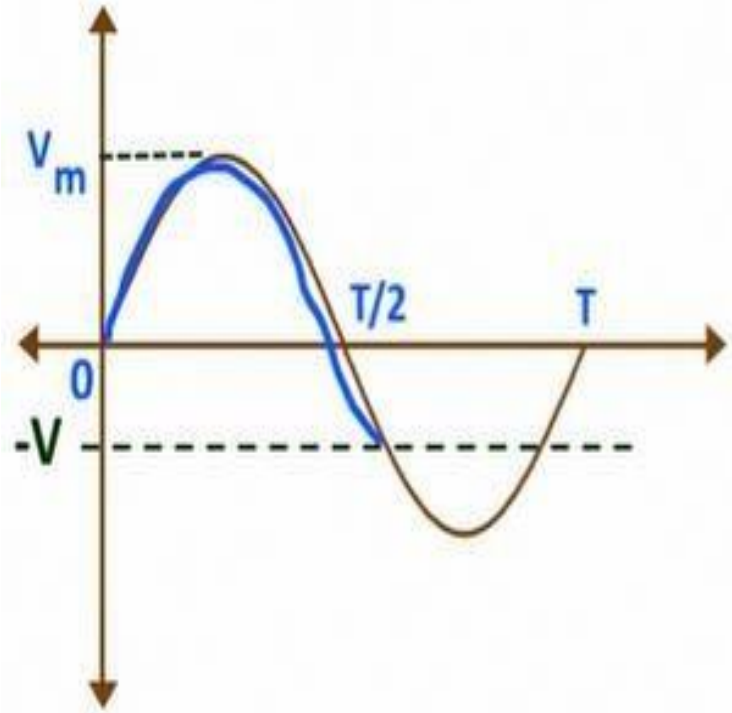
NEGATIVE CLIPPER – NEGATIVE BIASED

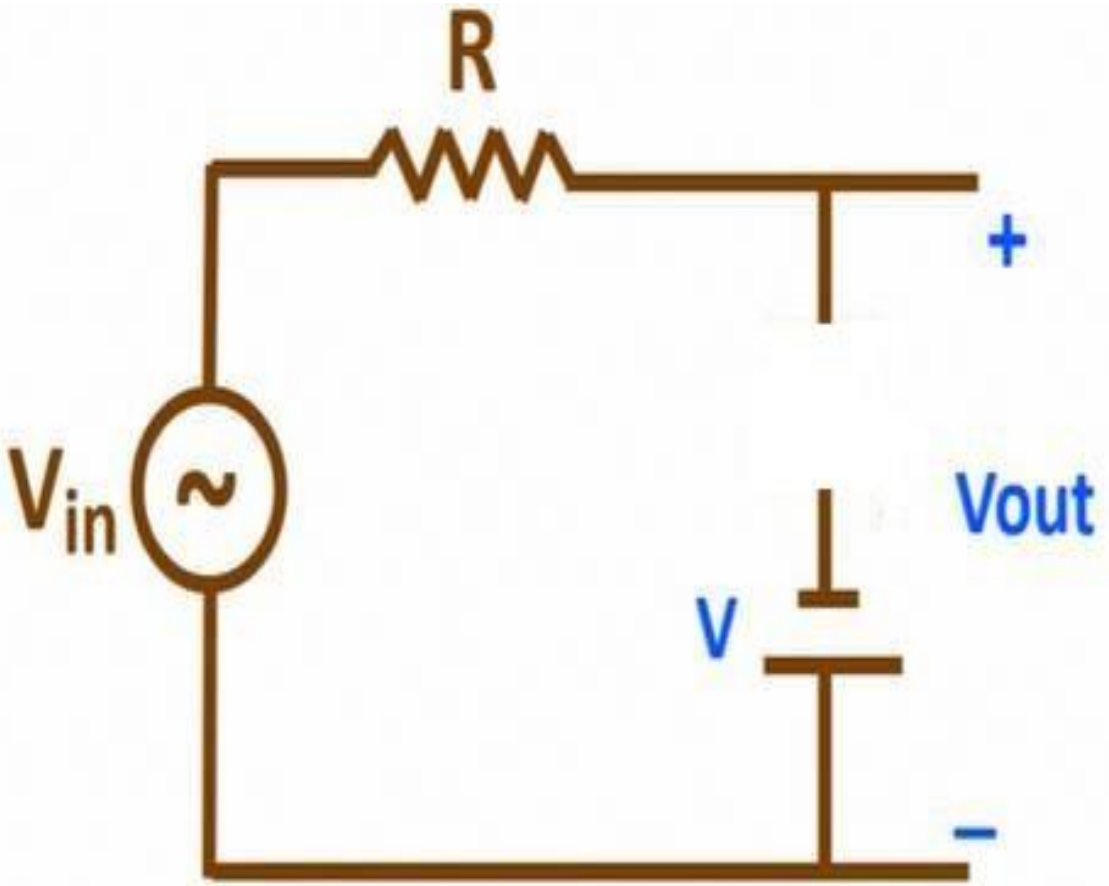
- In Biased Negative Clipper (Negative Biased), Is a Negative Clipper in which Negative terminal of the battery is connected to the Anode of the diode.





NEGATIVE CLIPPER – NEGATIVE BIASED

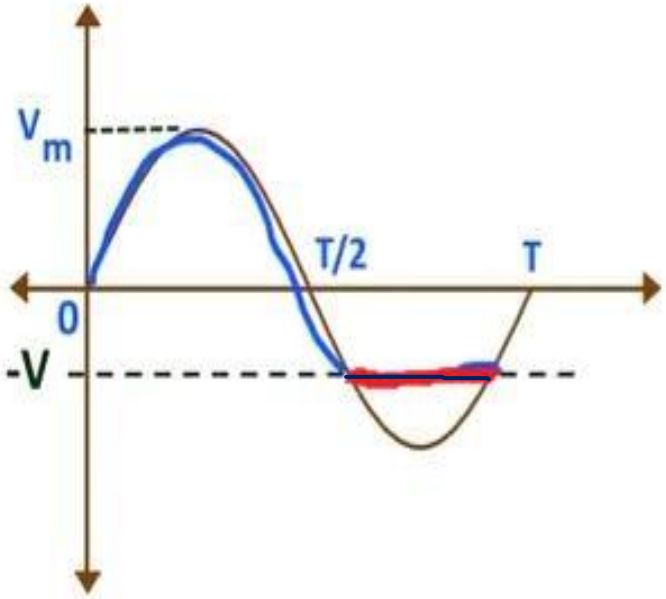


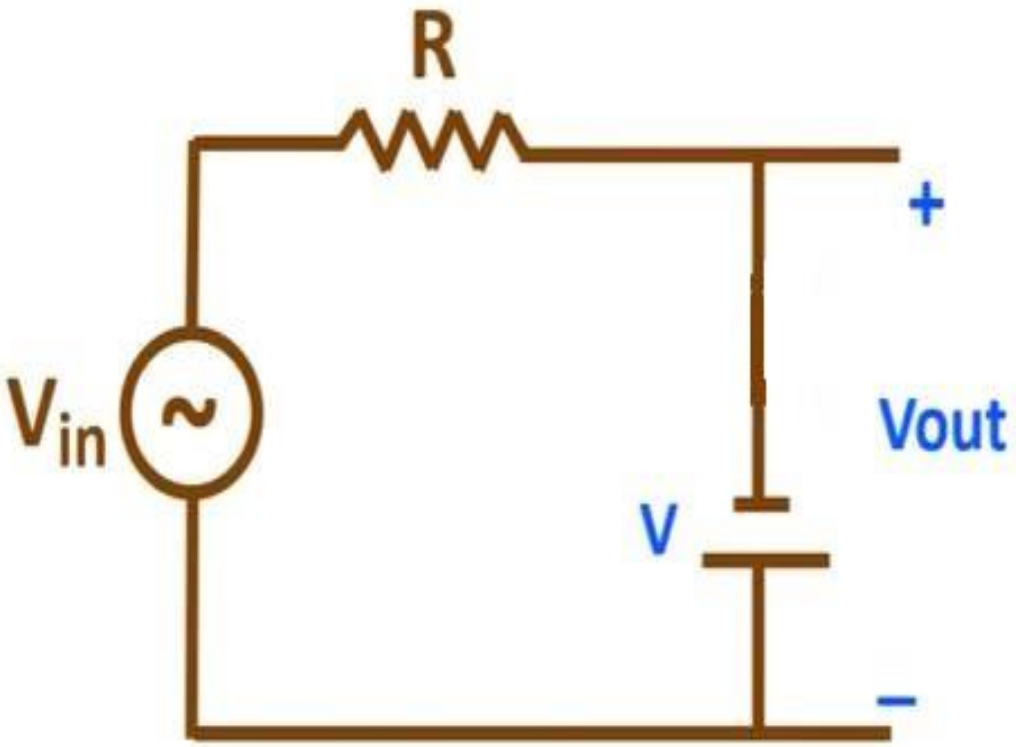


Vin > V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – NEGATIVE BIASED

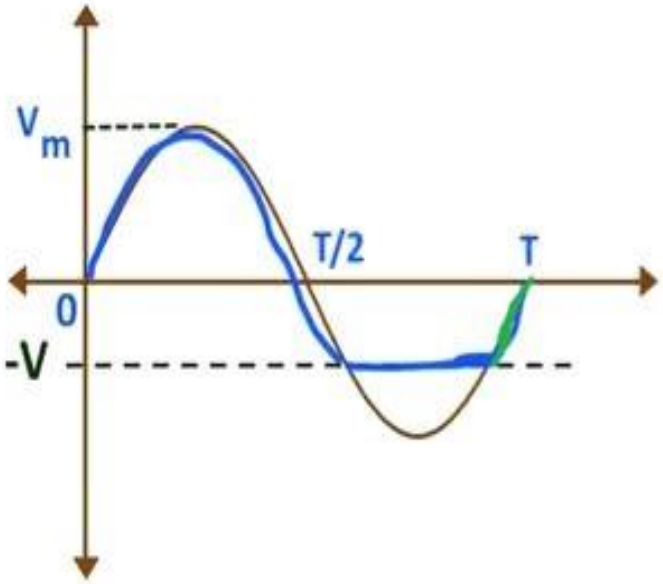


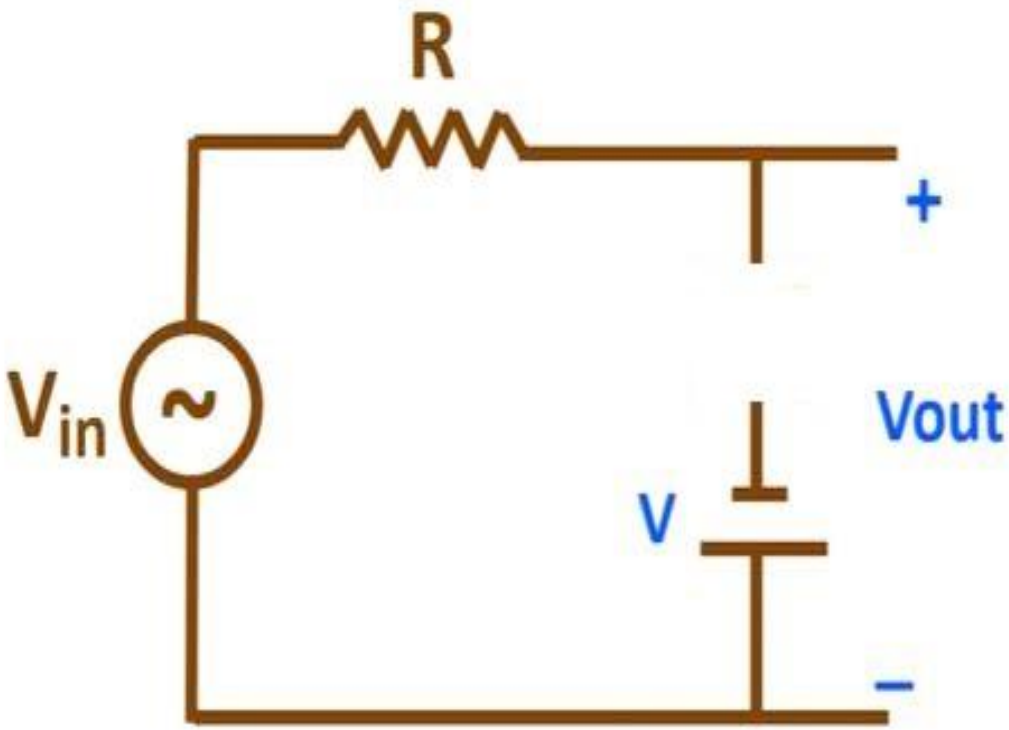


Vin < V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – NEGATIVE BIASED

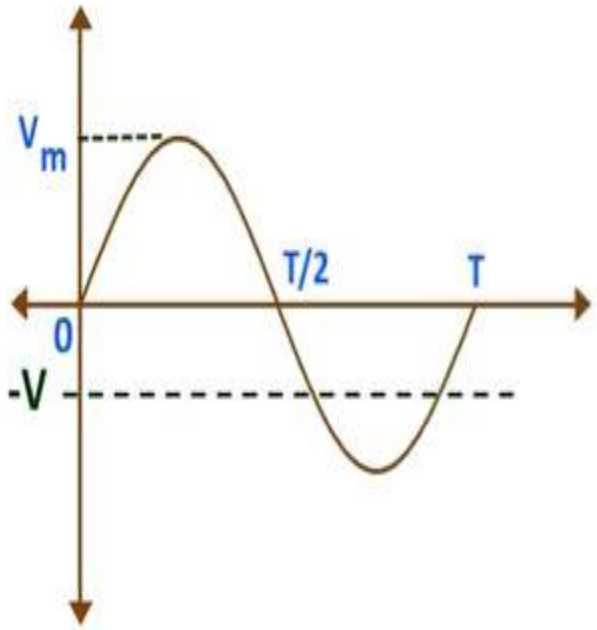


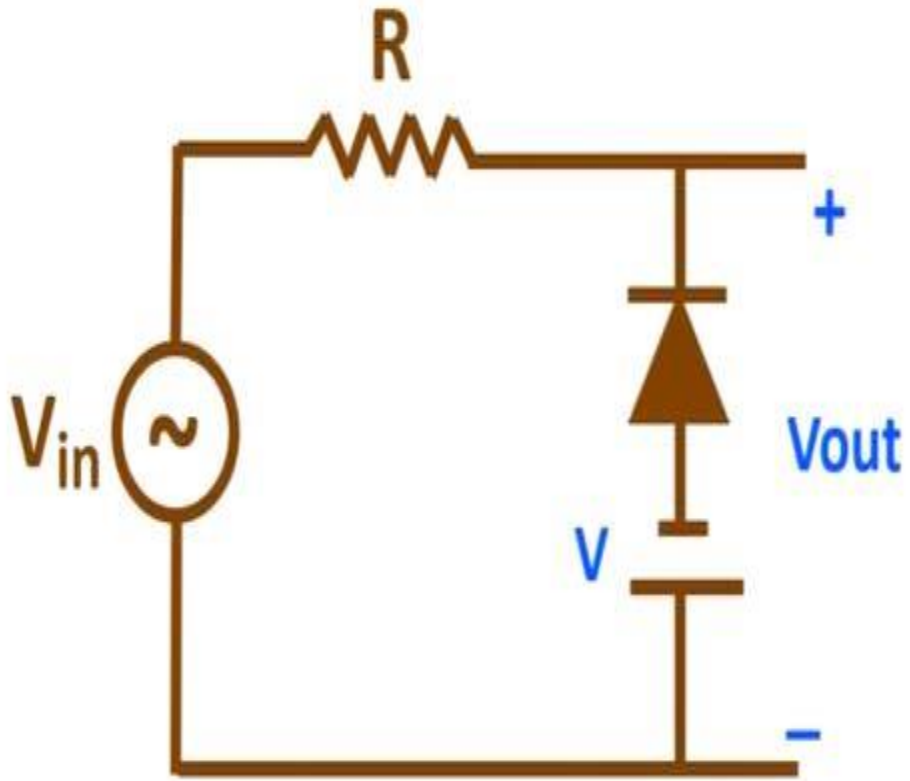


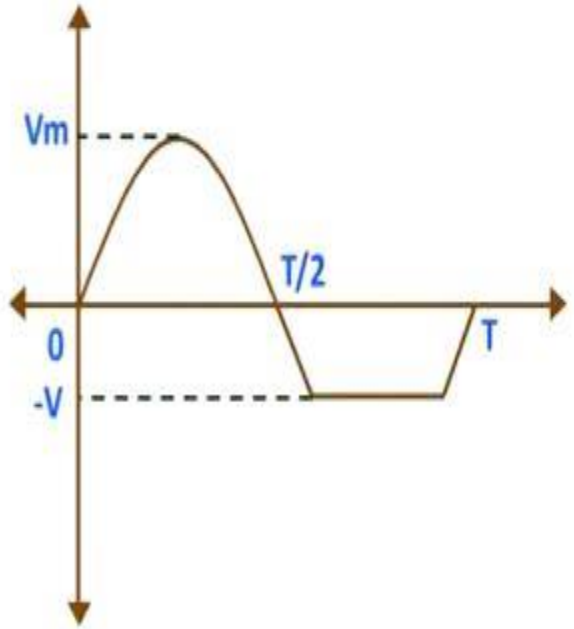
Vin > V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – NEGATIVE BIASED

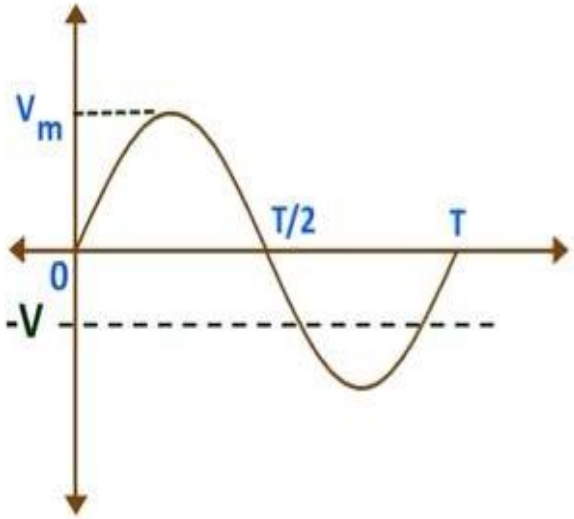


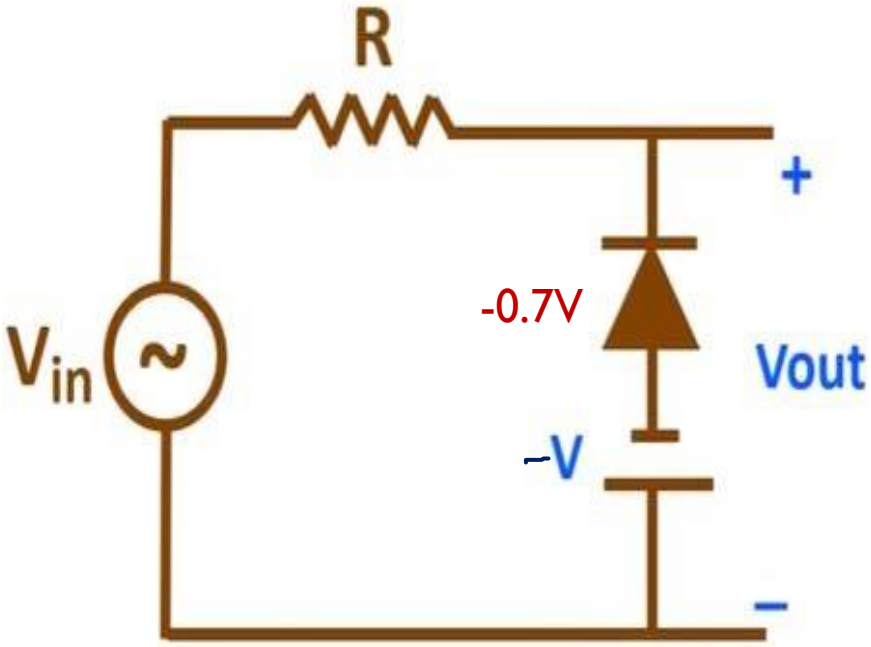


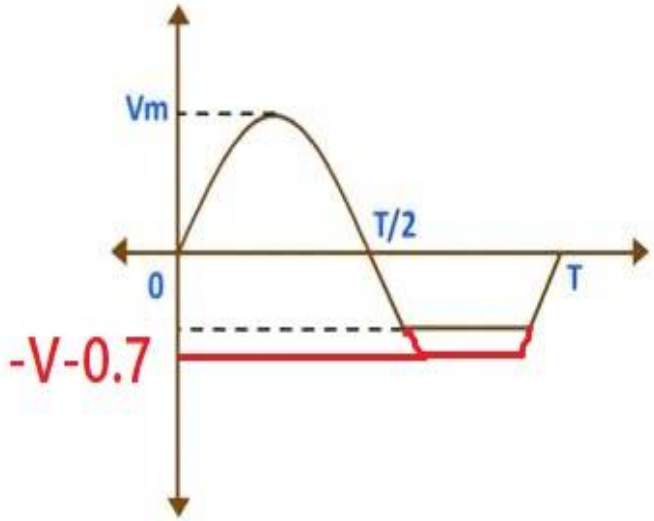


SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – NEGATIVE BIASED





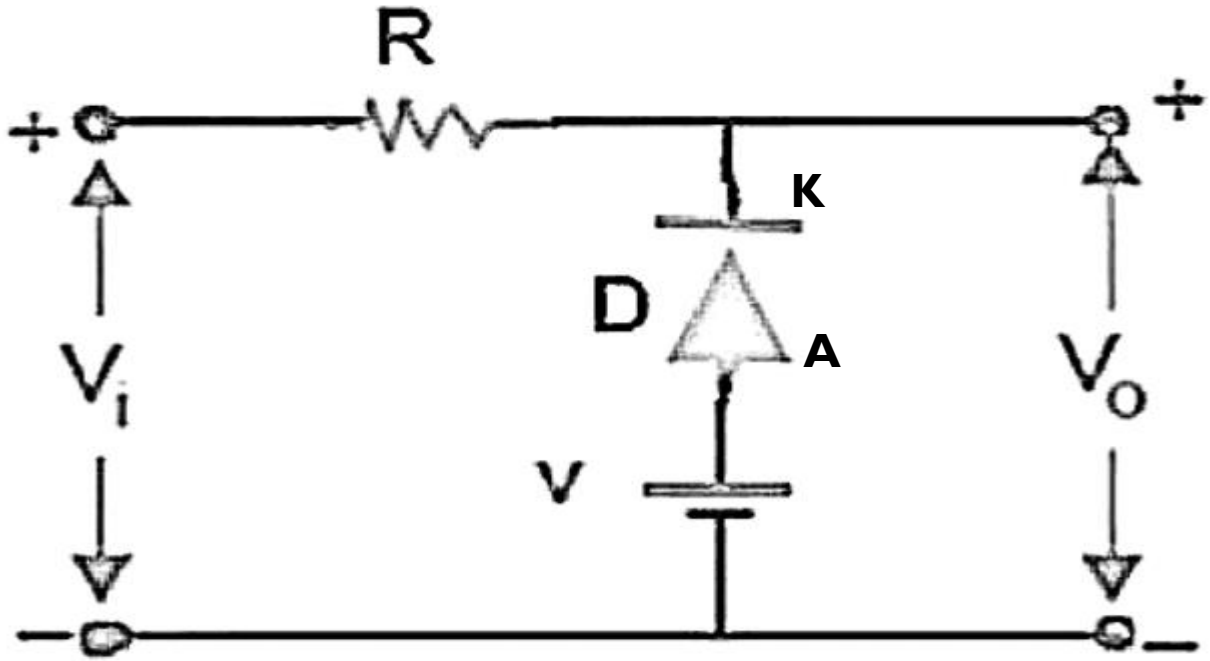


NON IDEAL CASE

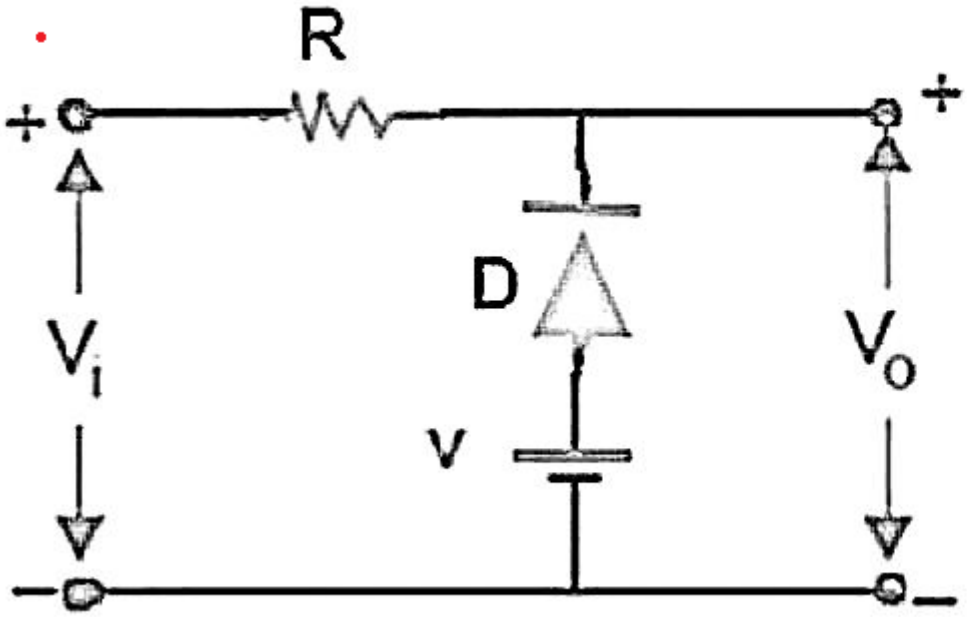
SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

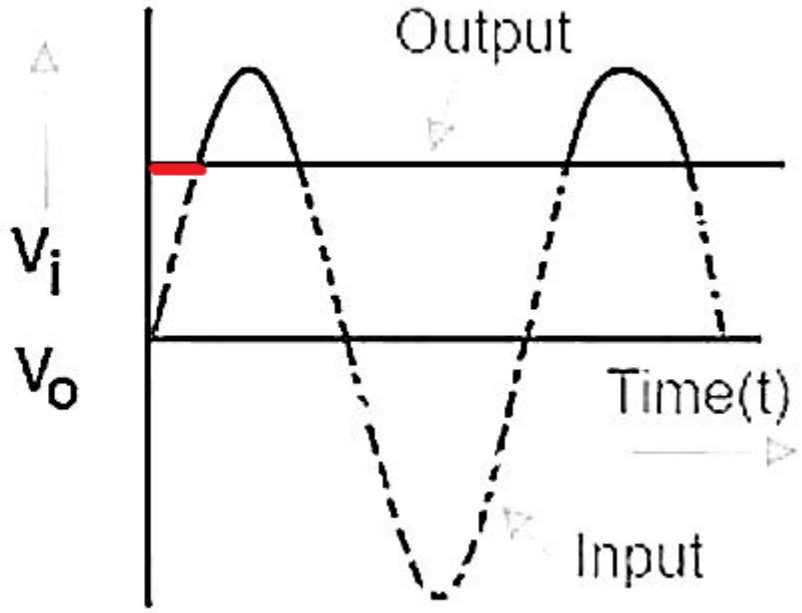
NEGATIVE CLIPPER – POSITIVE BIASED

- In Biased Negative Clipper (Positive Biased), Is a Negative Clipper in which Positive terminal of the battery is connected to the Anode of the diode.



NEGATIVE CLIPPER – POSITIVE BIASED

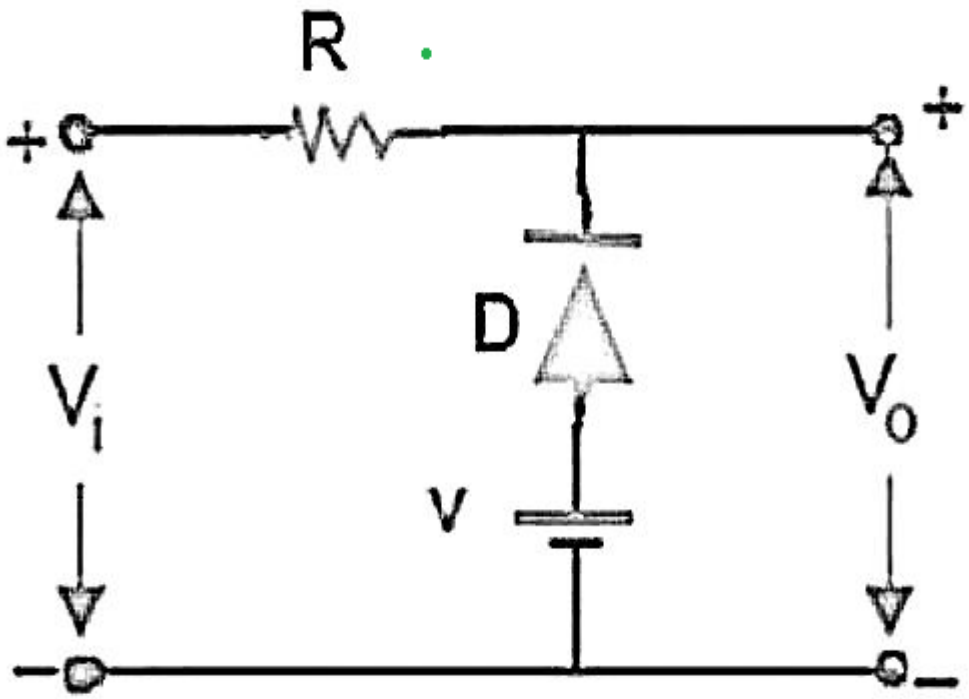




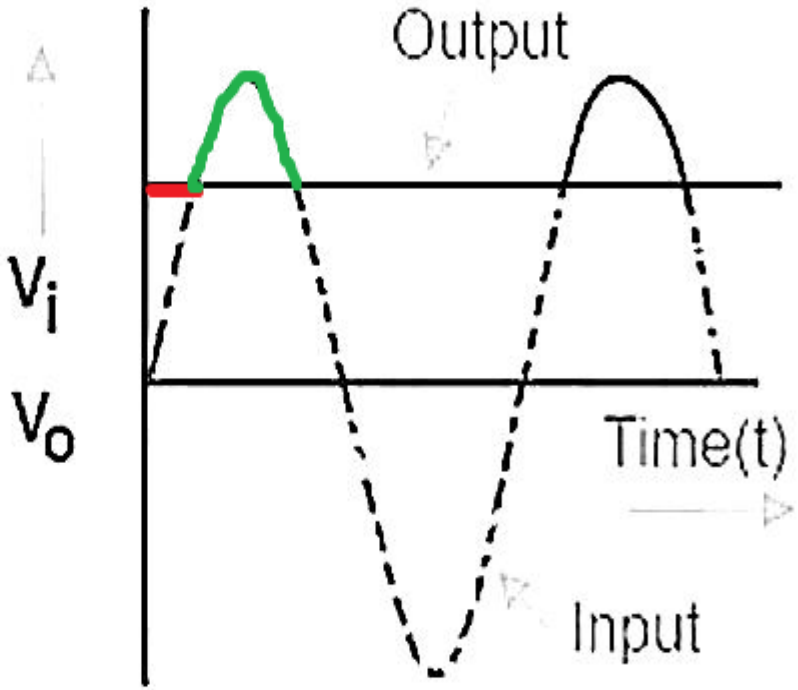
Vin < V

SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – POSITIVE BIASED

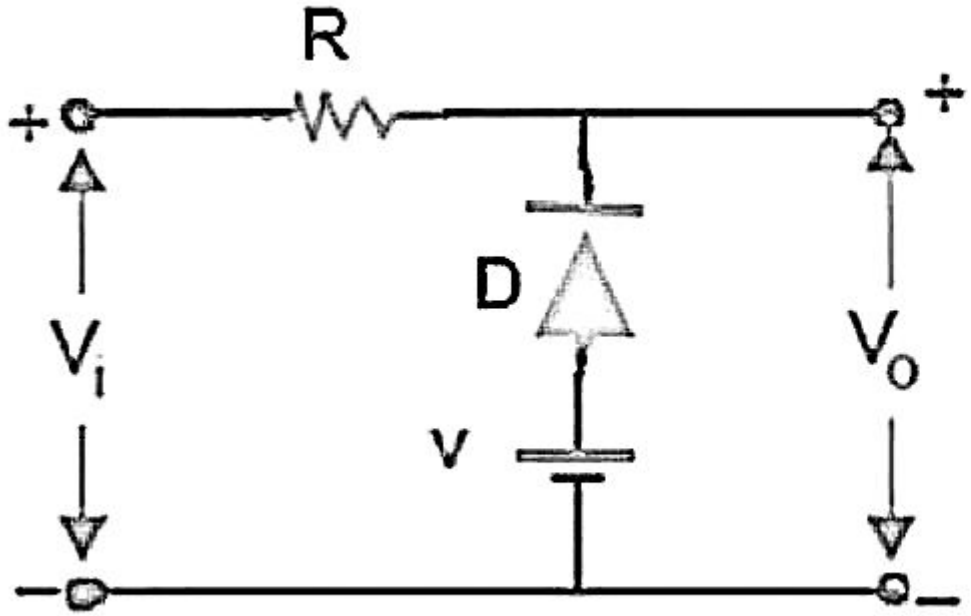


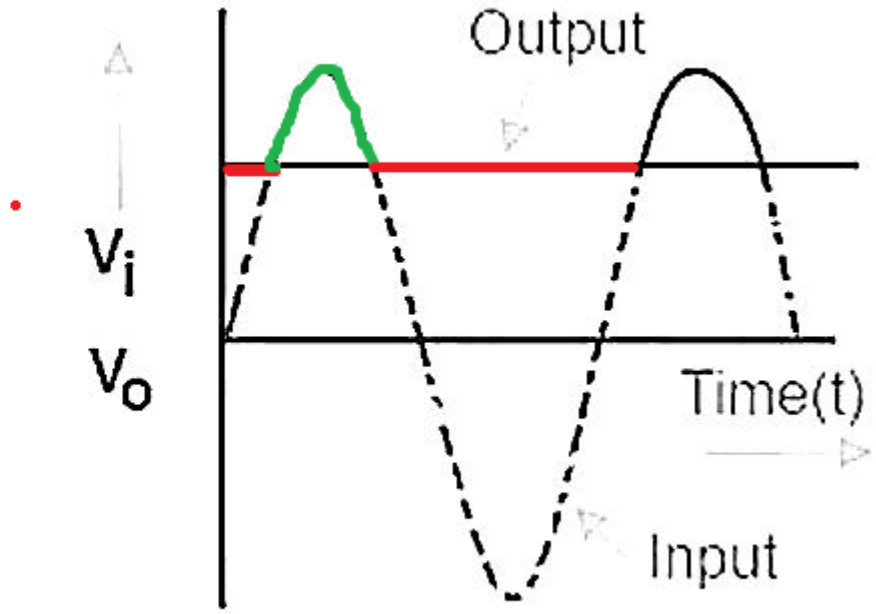
Vin > V



SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

NEGATIVE CLIPPER – POSITIVE BIASED



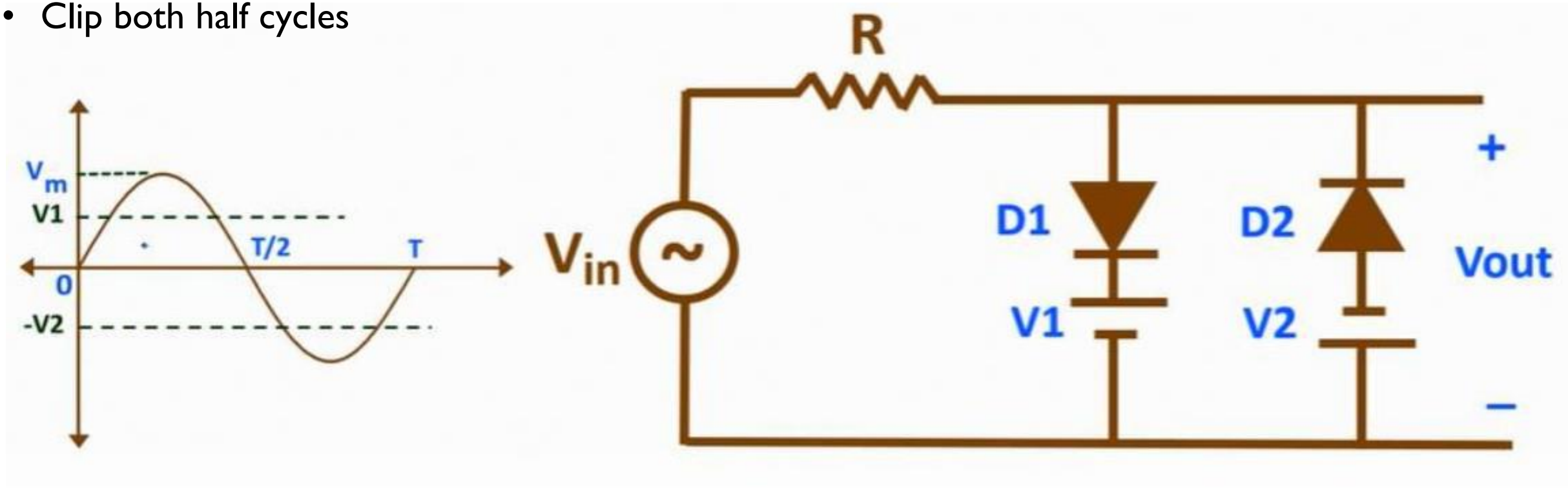


Vin < V

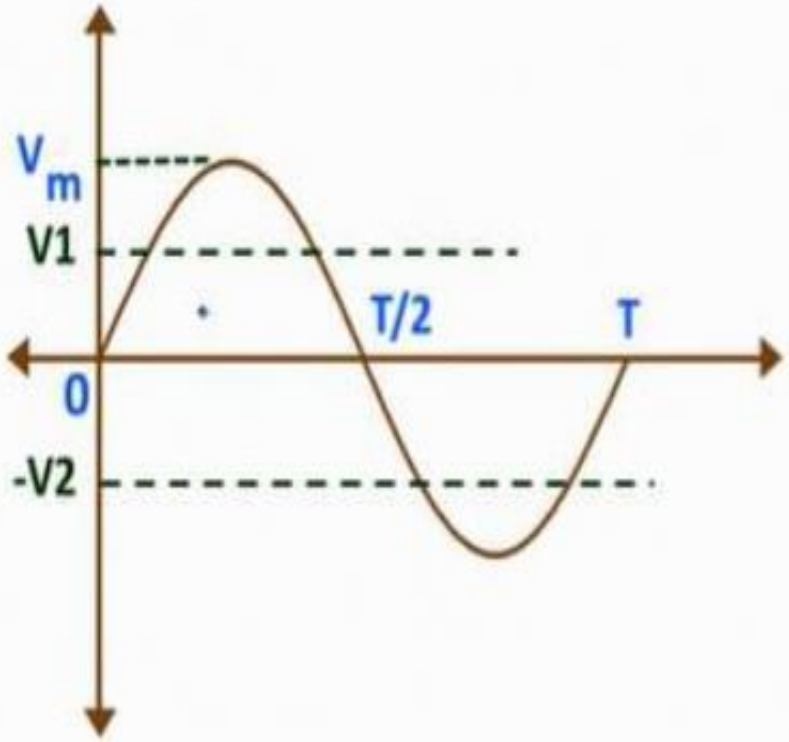
SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

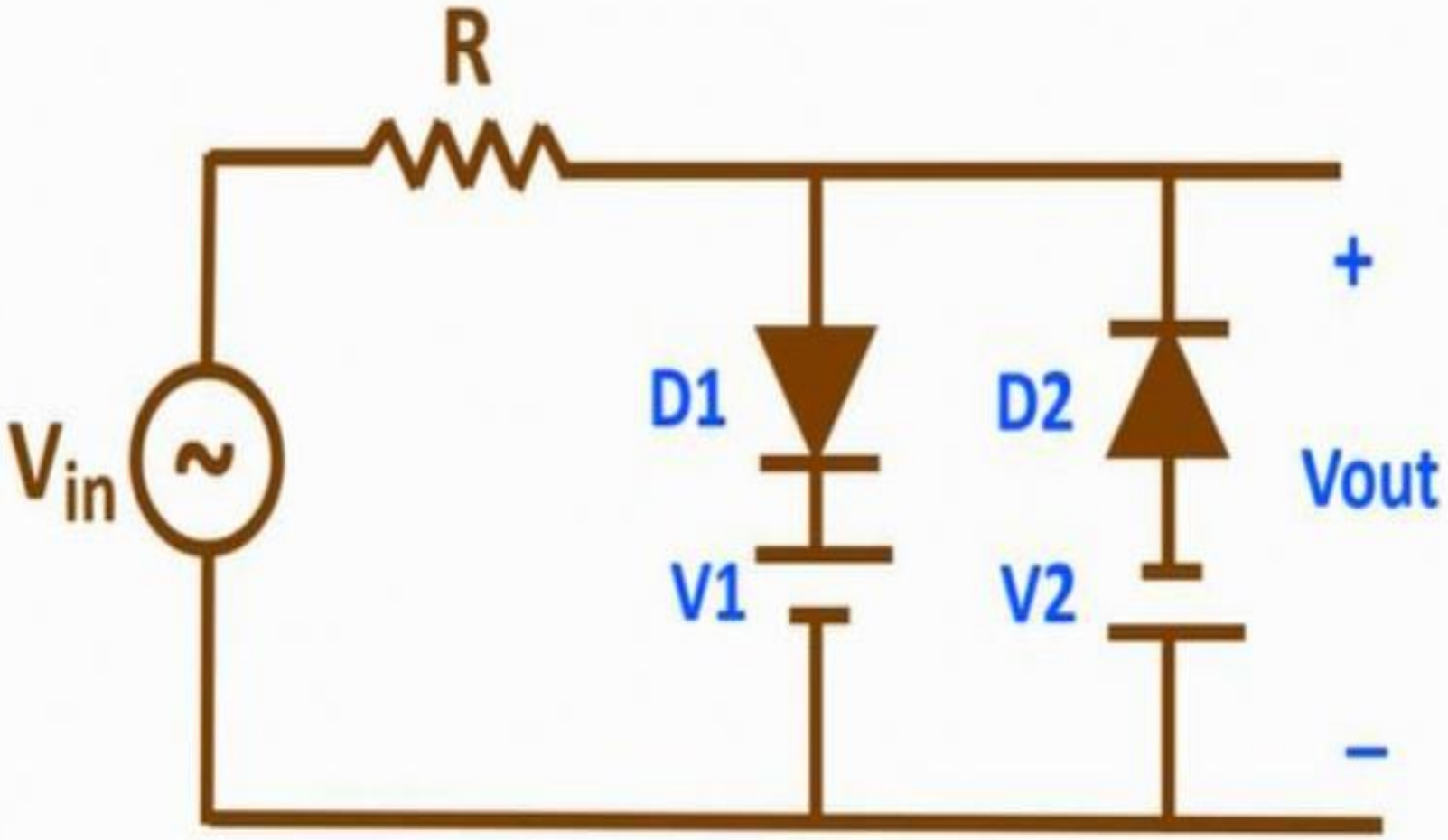
COMBINATIONAL CLIPPERS

- Combination of Positive Clipper with Positive Bias and Negative Clipper with Negative Bias.
- Also called Dual Diode Clipper
- Clip both half cycles



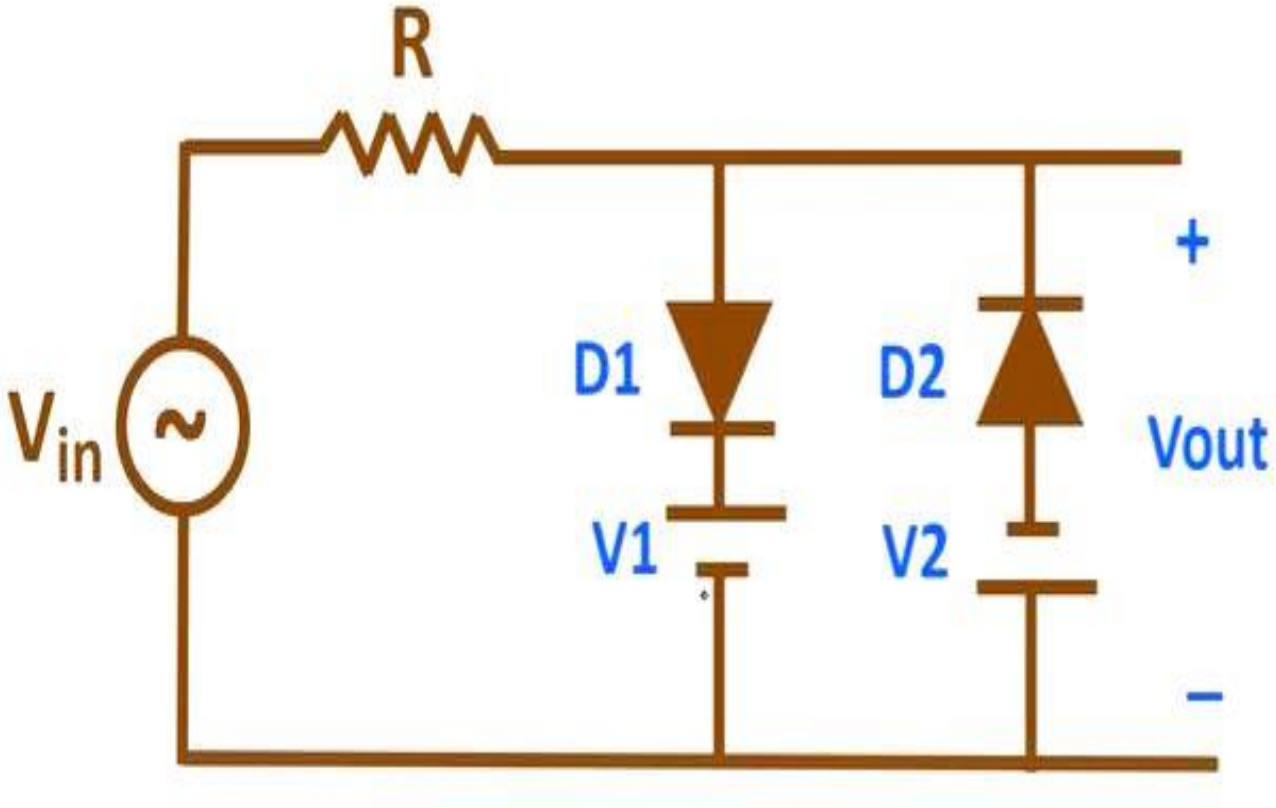
COMBINATIONAL CLIPPERS

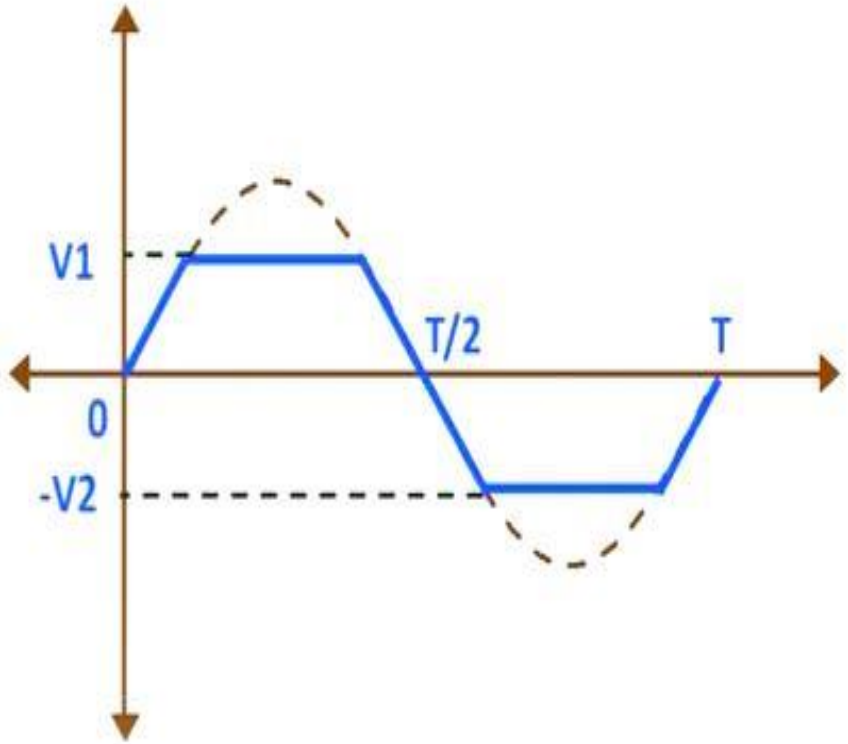




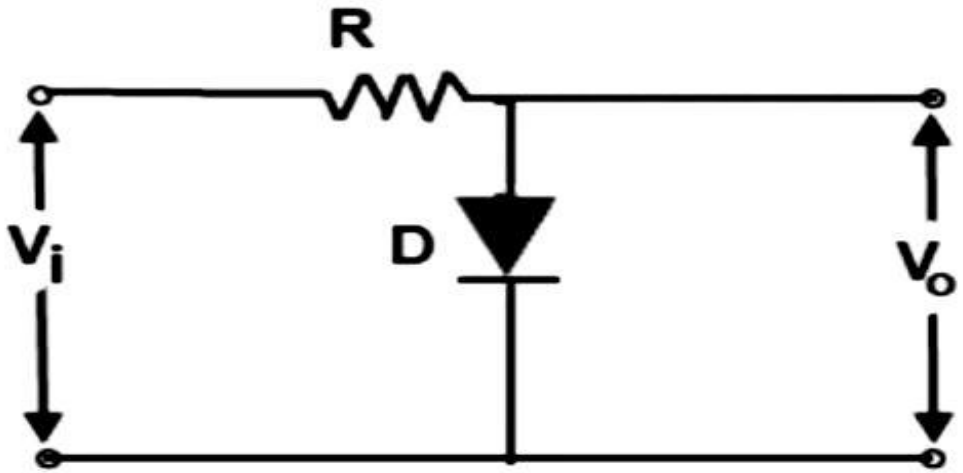
SHUNT OUTPUT
FB – 0 OR BATTERY VOLTAGE
RB – INPUT VOLTAGE

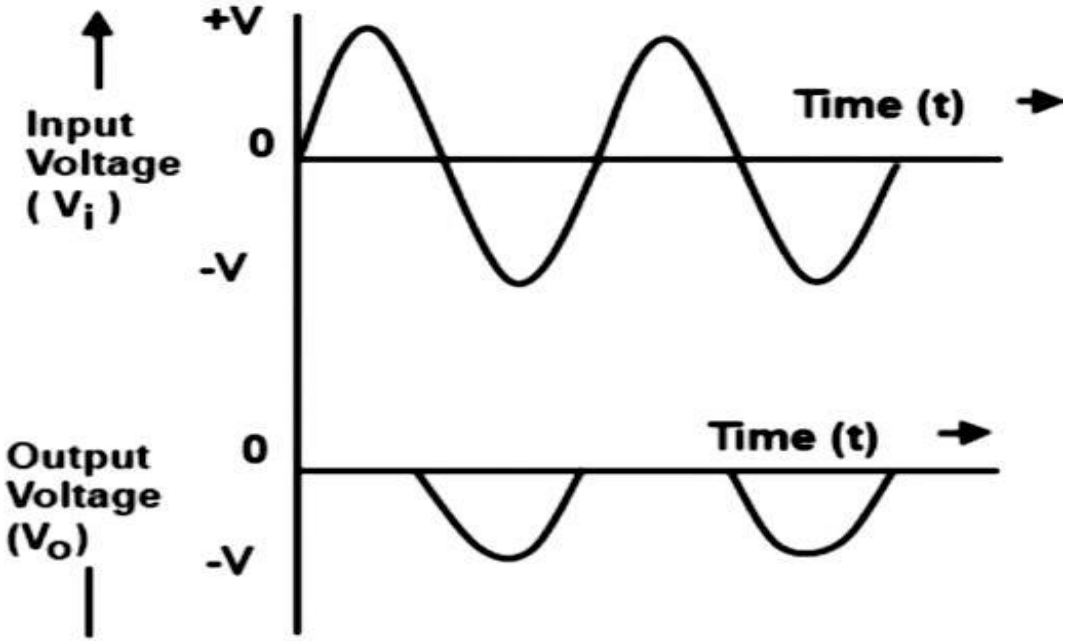
COMBINATIONAL CLIPPERS

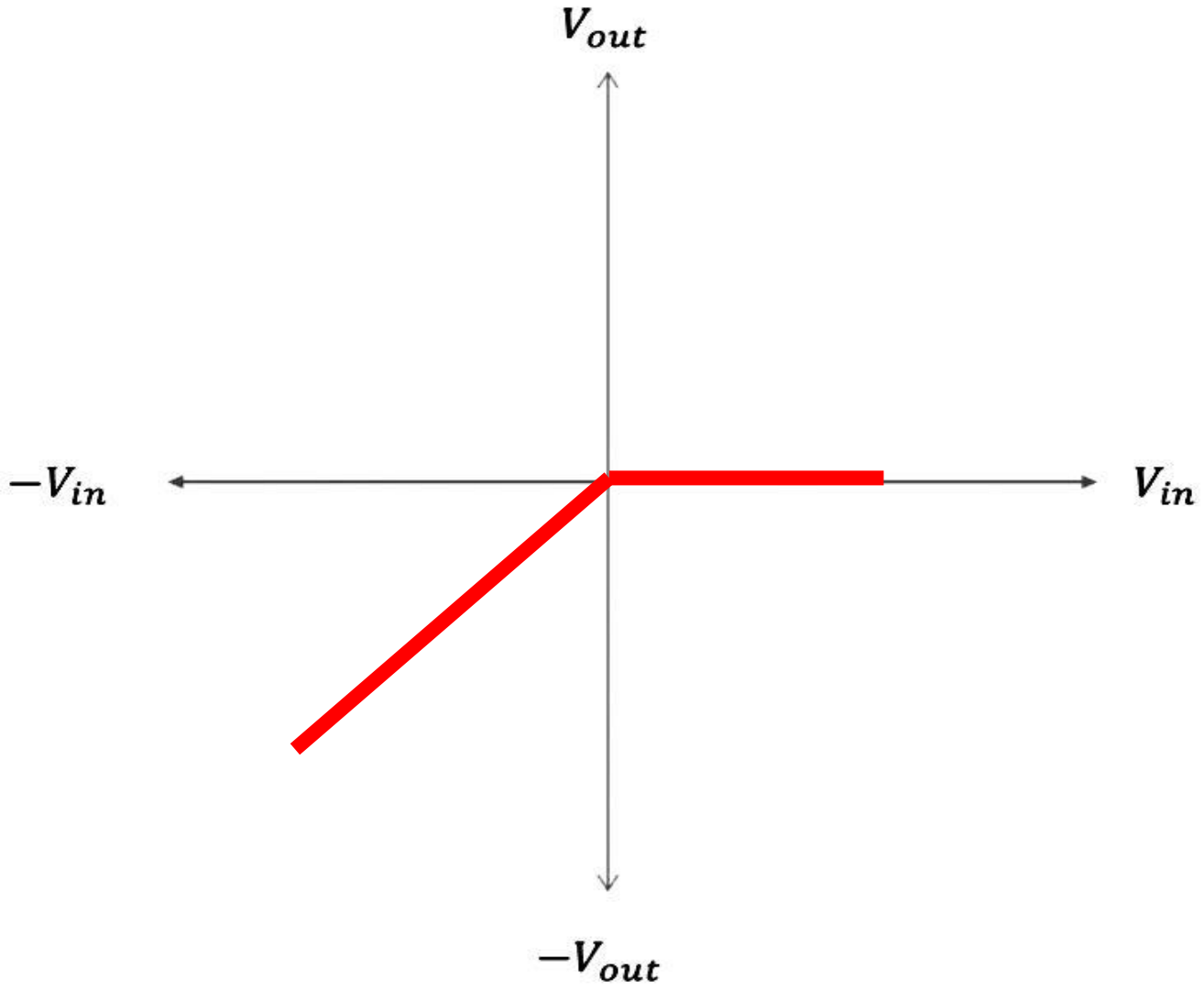




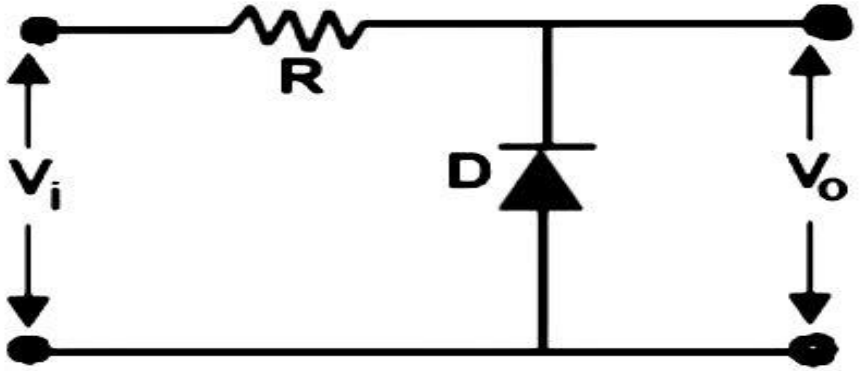
TRANSFER CHARACTERISTICS- SHUNT POSITIVE CLIPPER

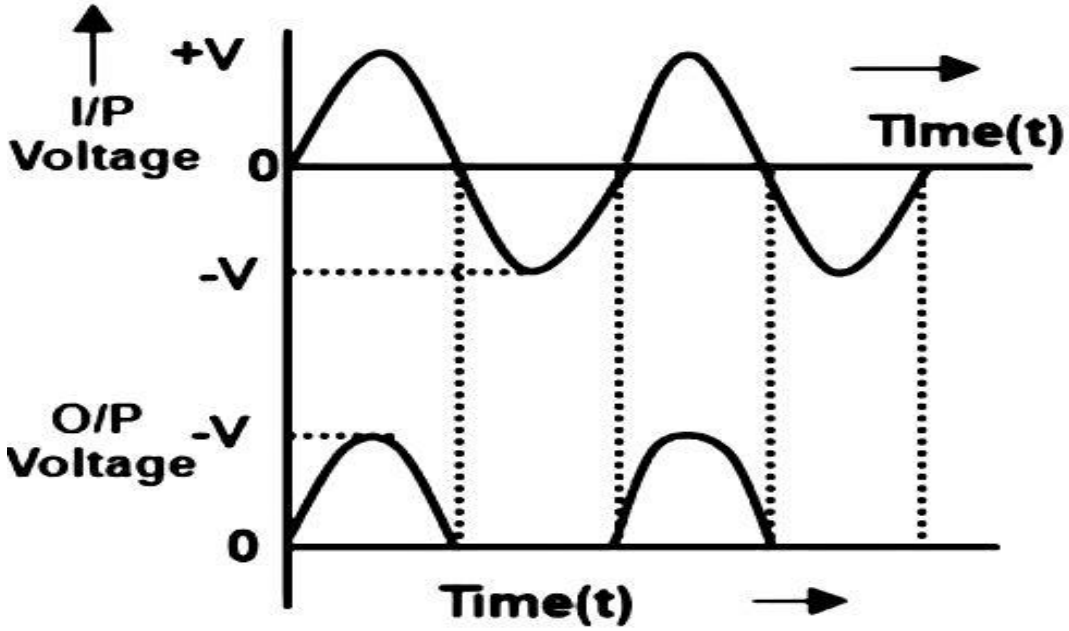


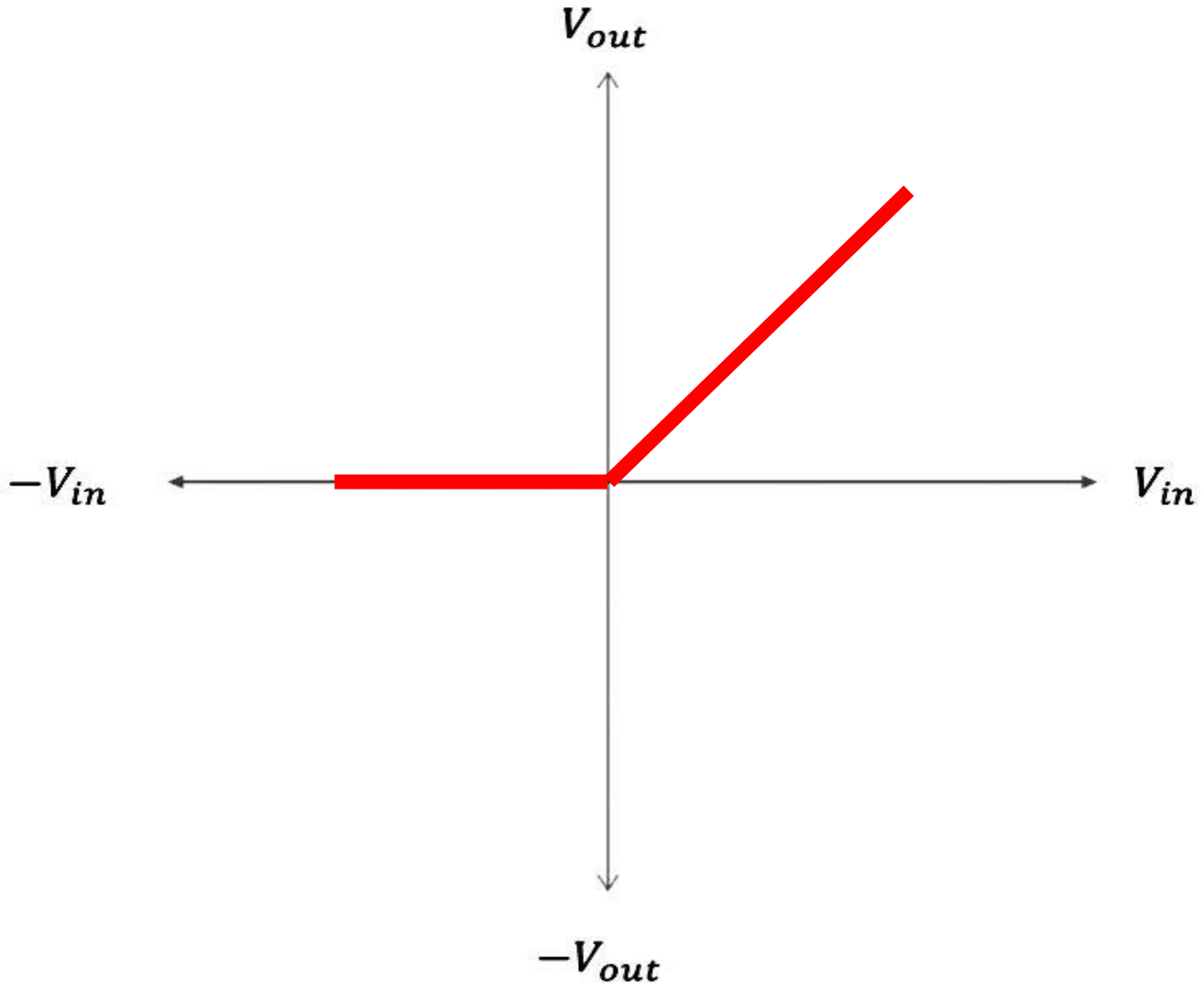




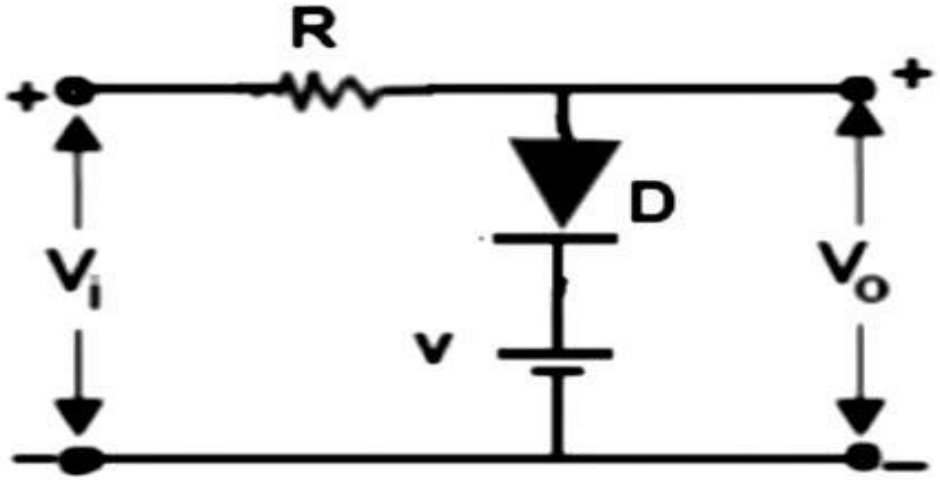
TRANSFER CHARACTERISTICS- SHUNT NEGATIVE CLIPPER

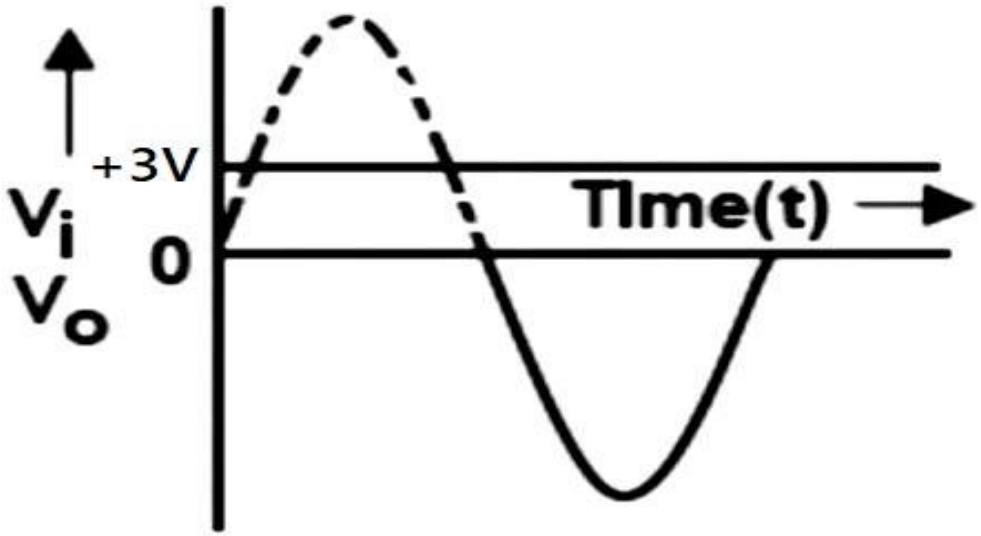


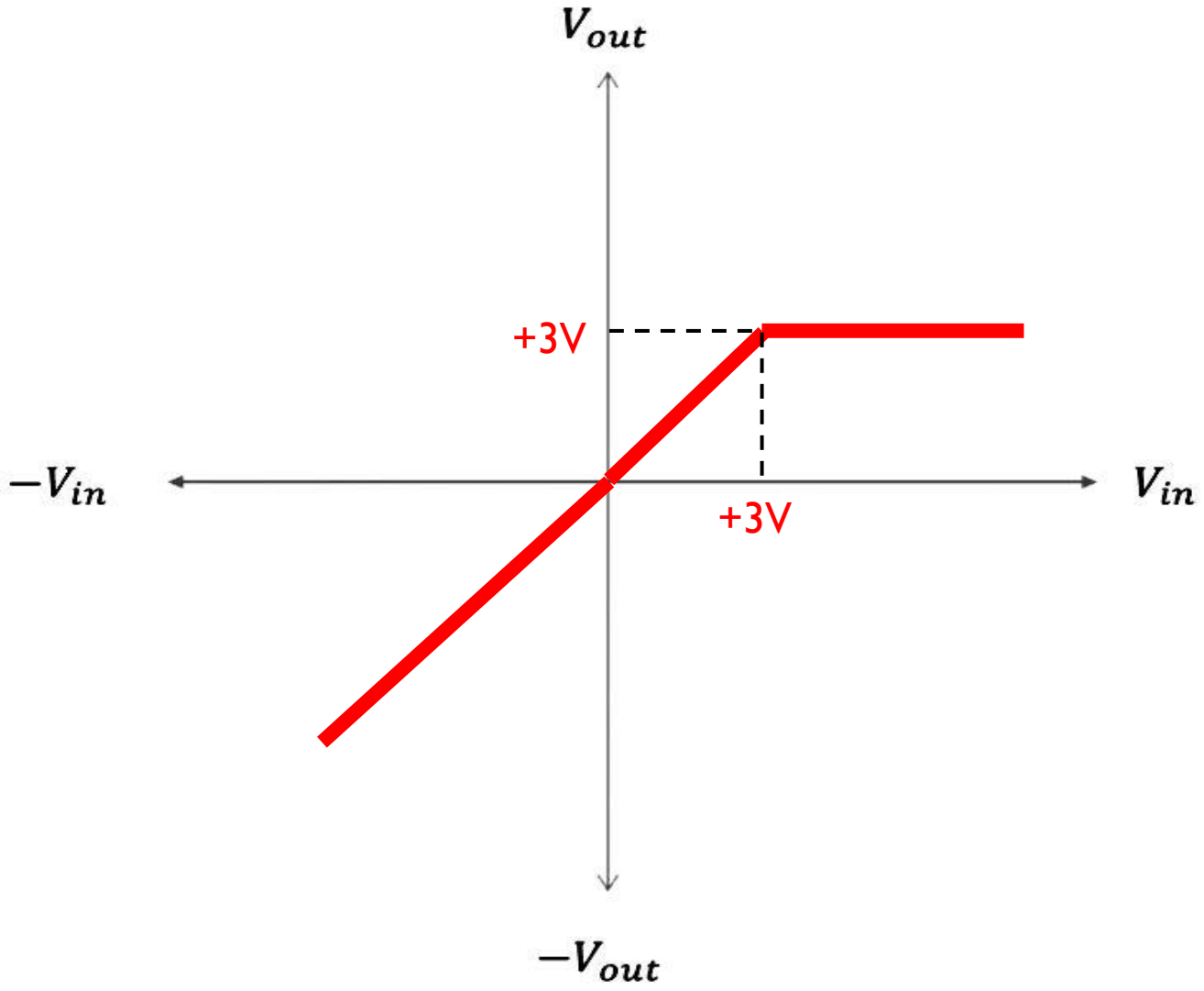




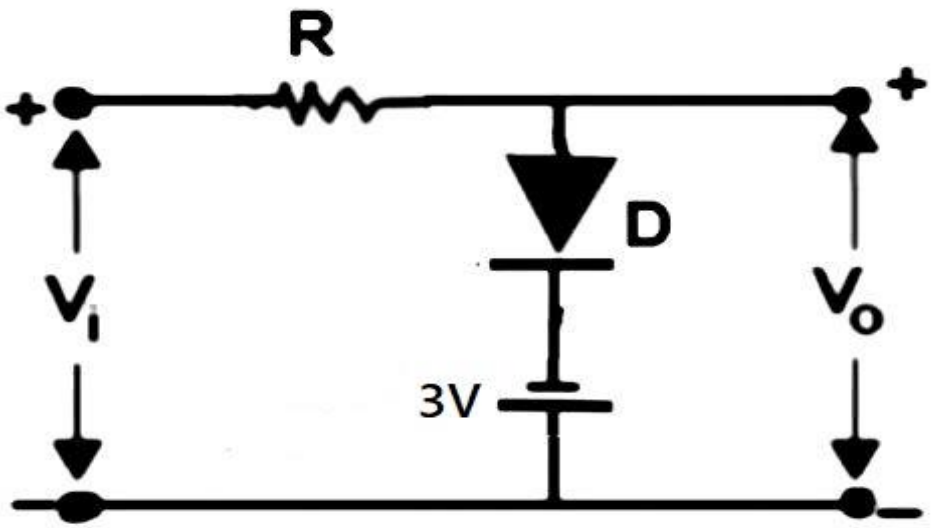
TRANSFER CHARACTERISTICS- Biased Positive Clipper (+Ve Biased)

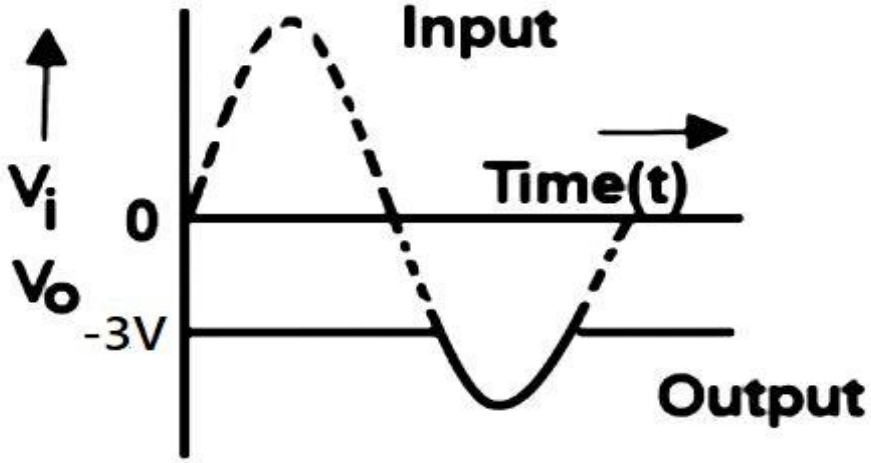


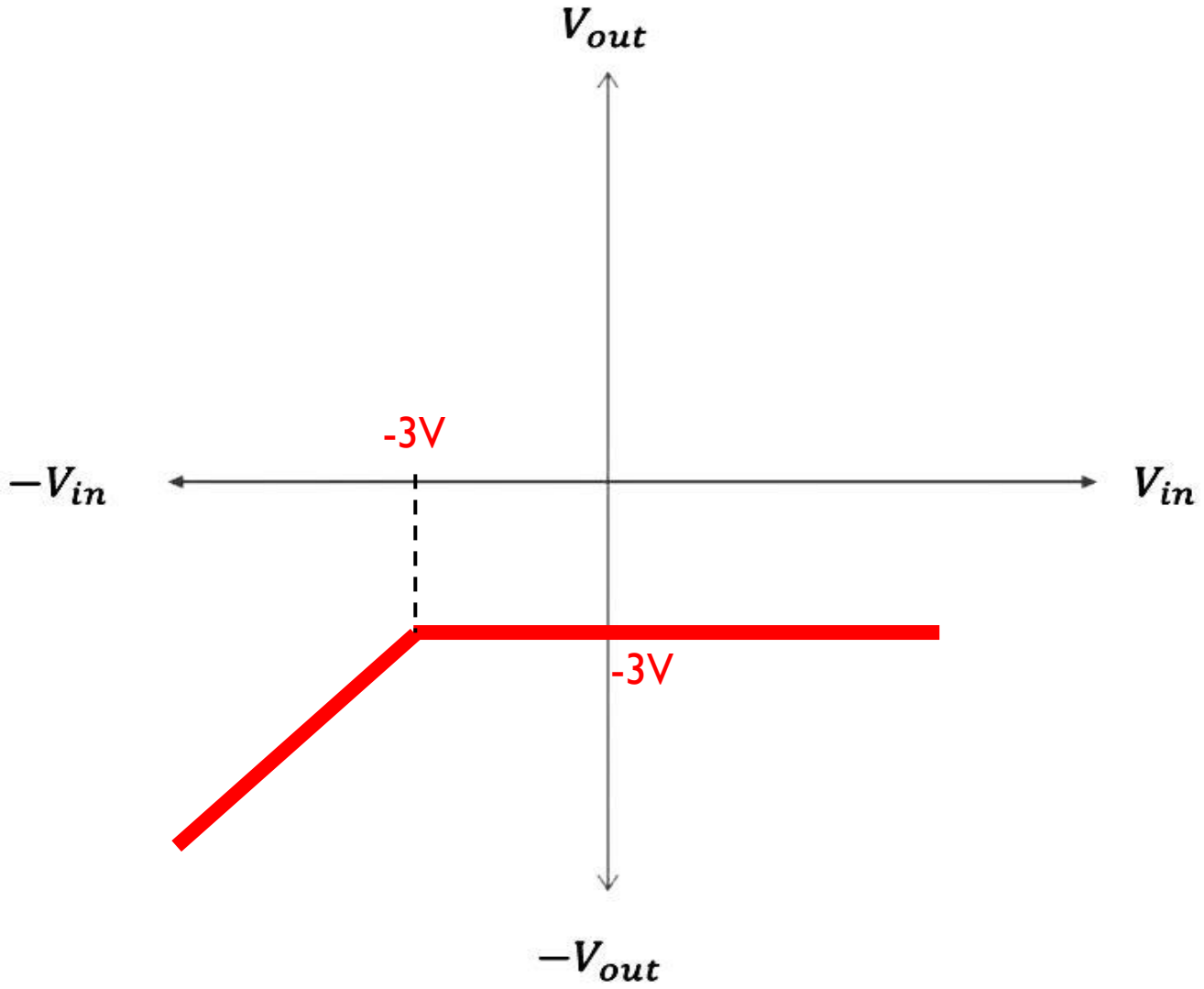




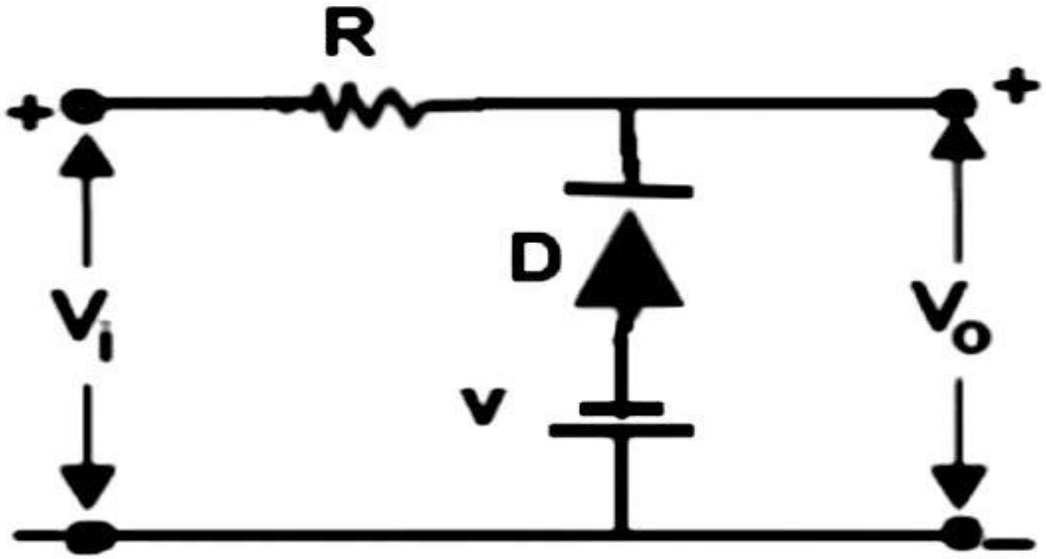
TRANSFER CHARACTERISTICS- Biased Positive Clipper (-Ve Biased)

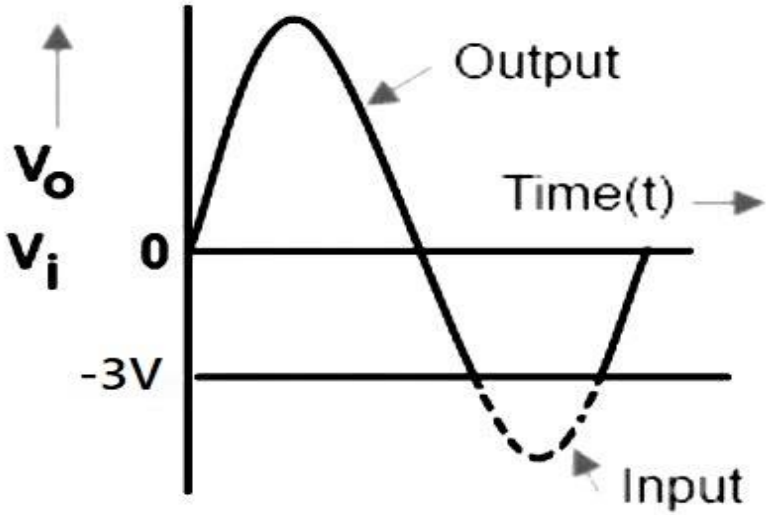


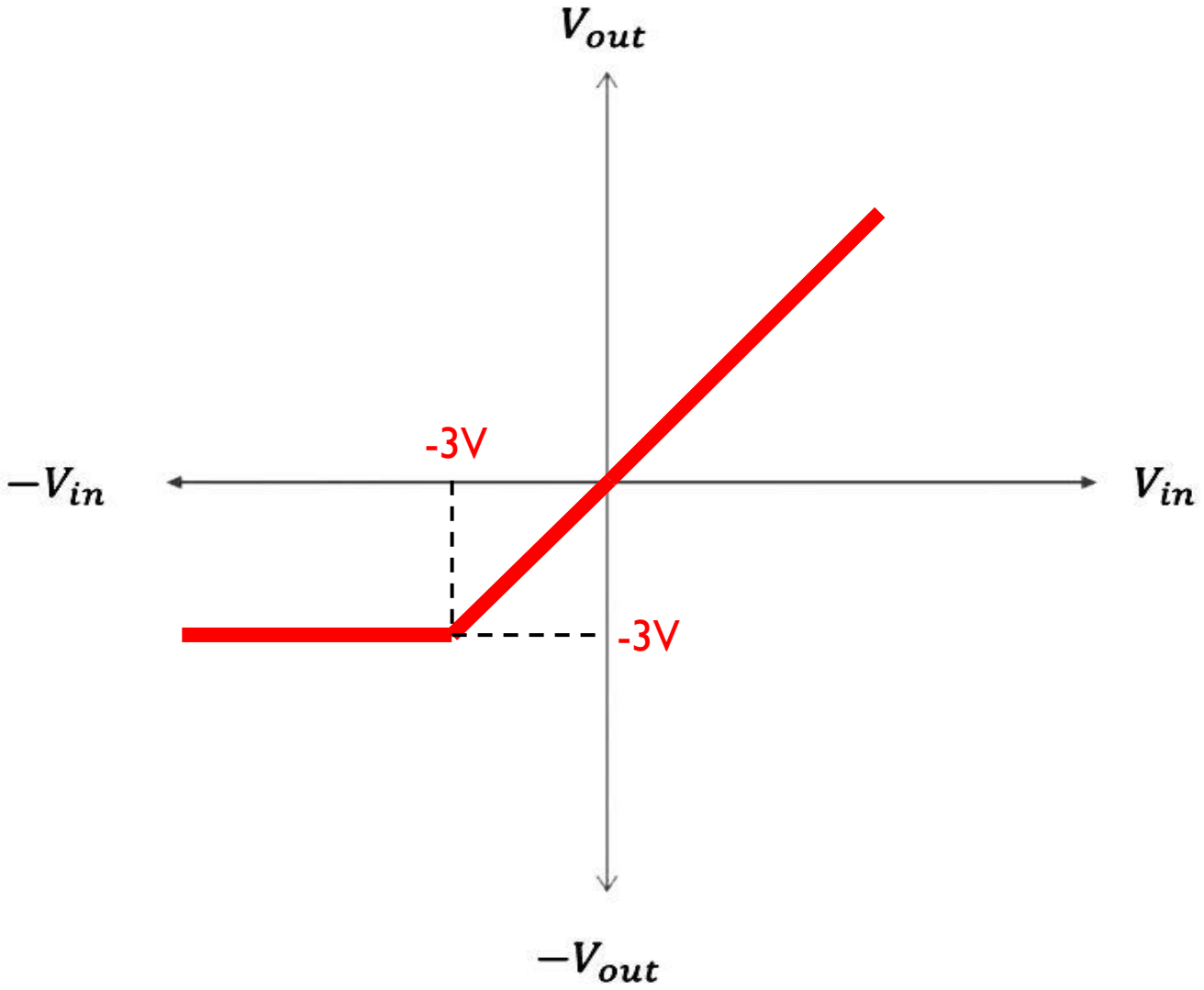




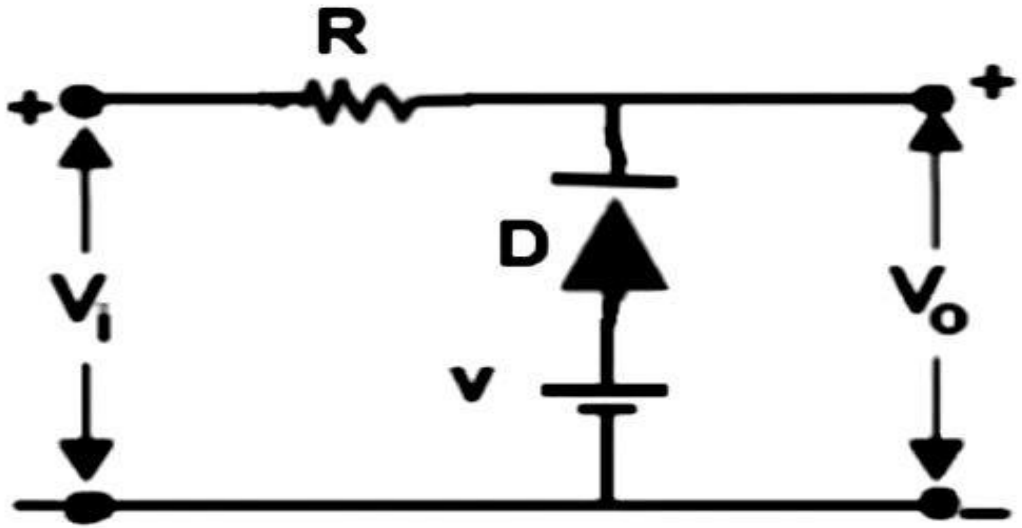
TRANSFER CHARACTERISTICS- Biased Negative Clipper (-Ve Biased)

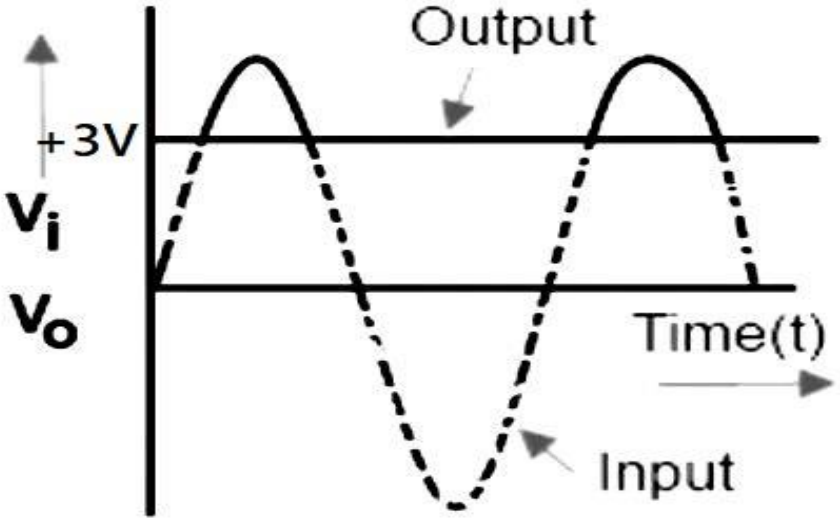


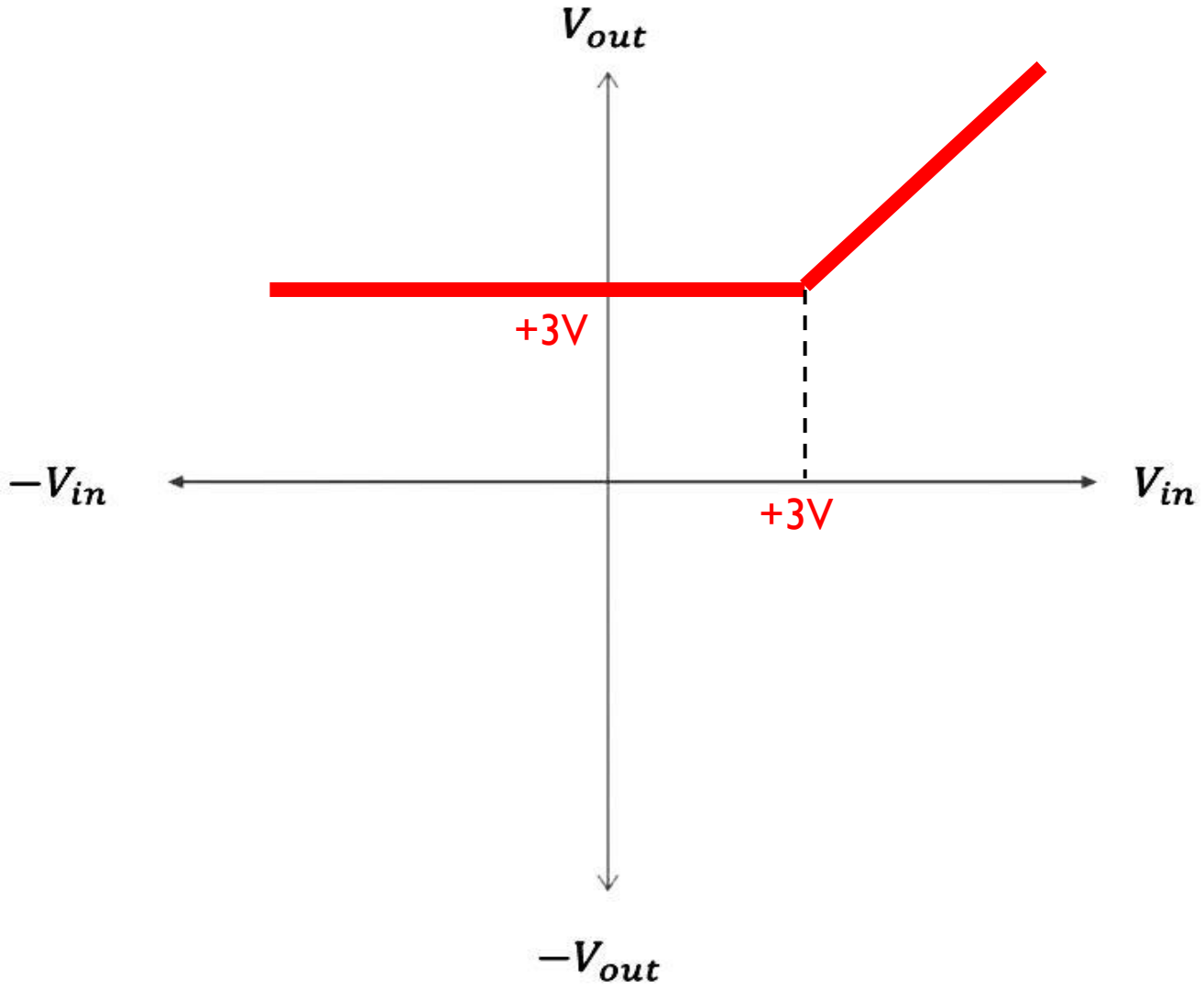




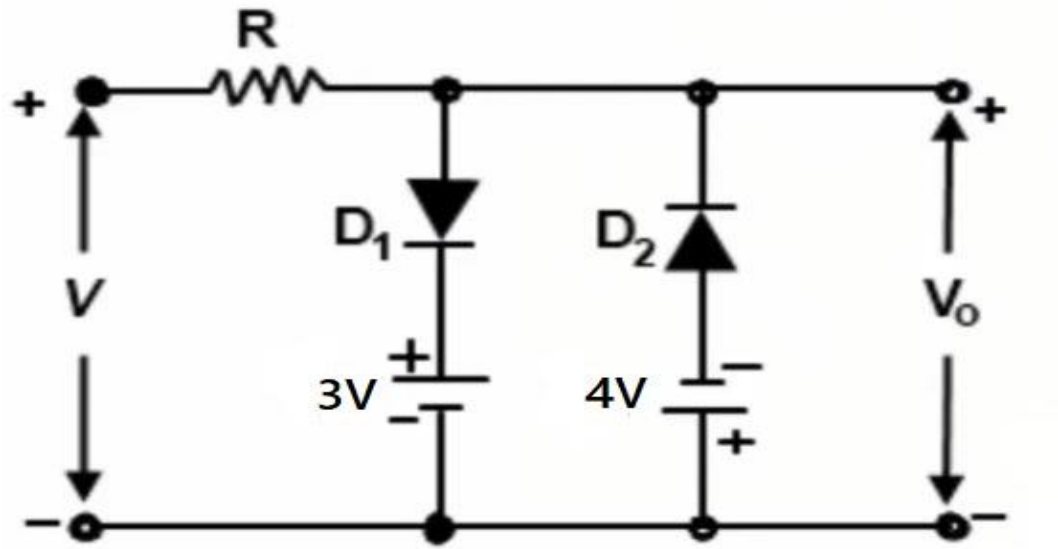
TRANSFER CHARACTERISTICS- Biased Negative Clipper (+Ve Biased)

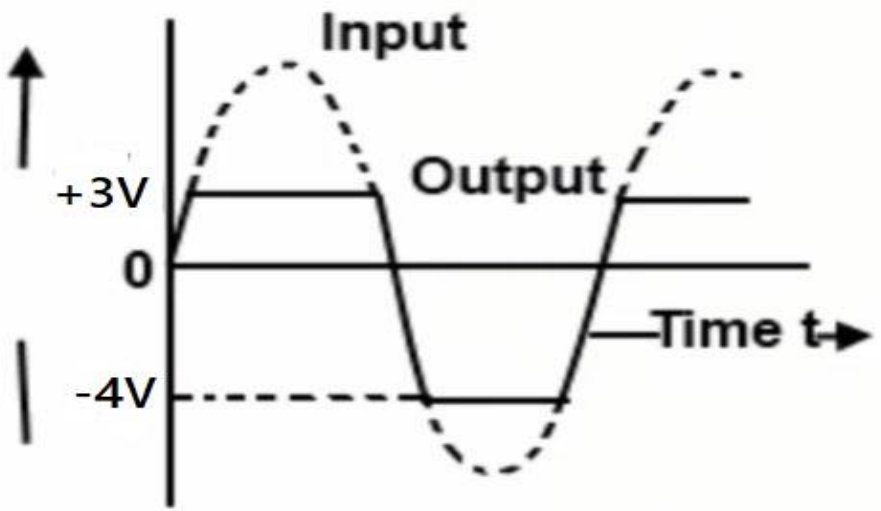


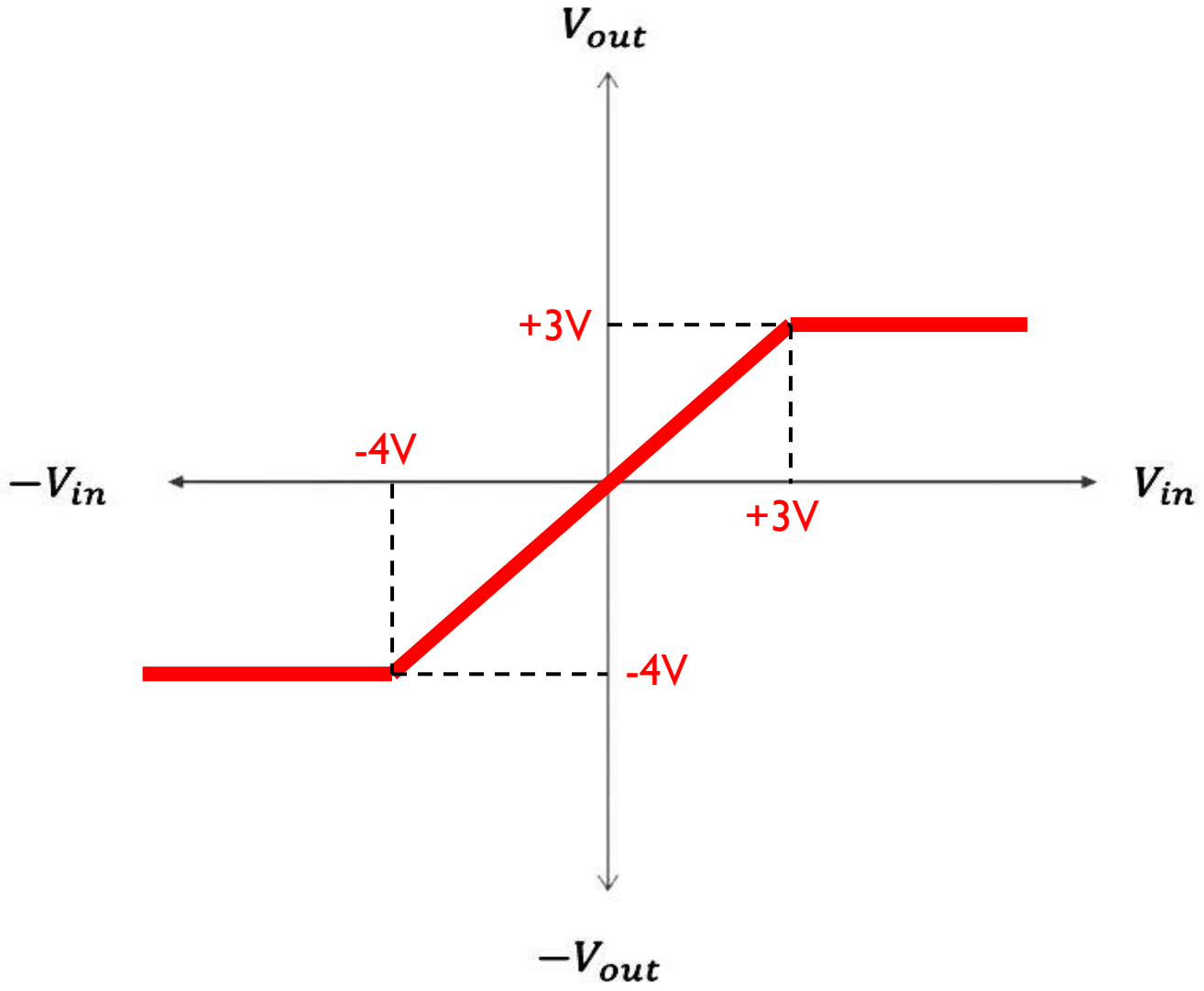




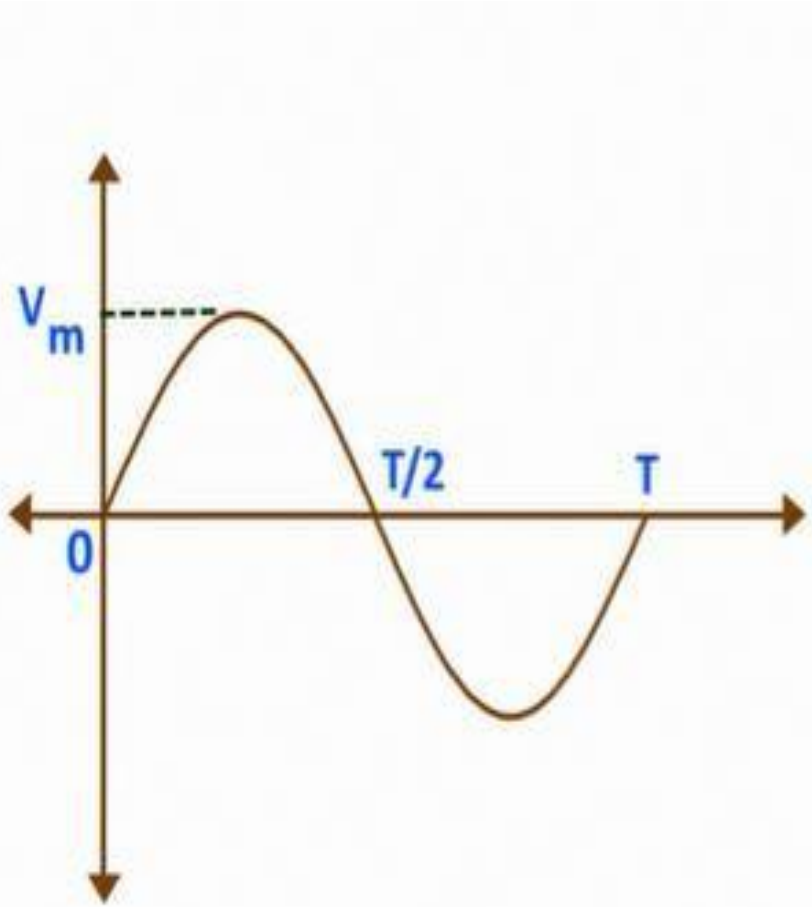
TRANSFER CHARACTERISTICS- Combinational Clipper

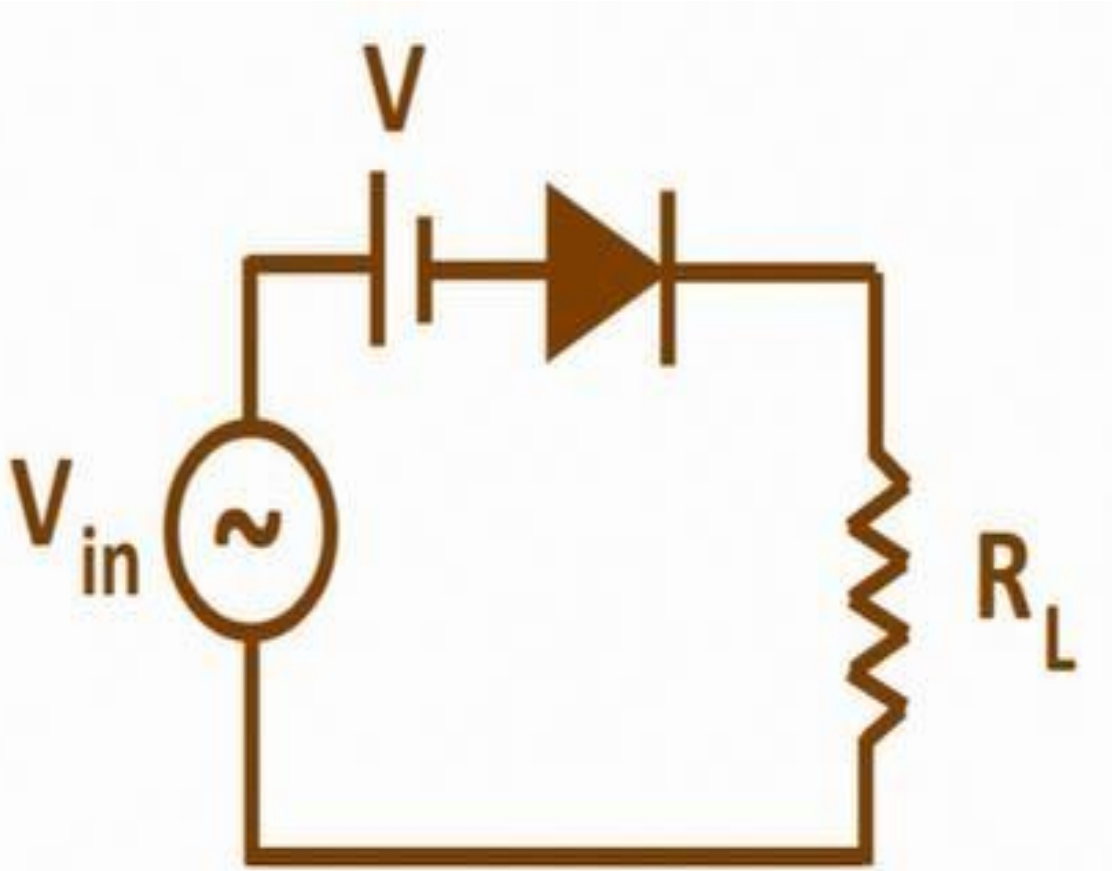


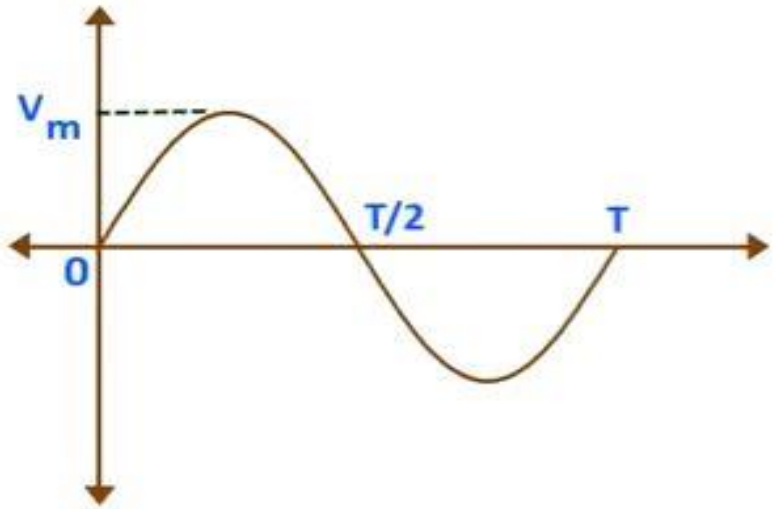


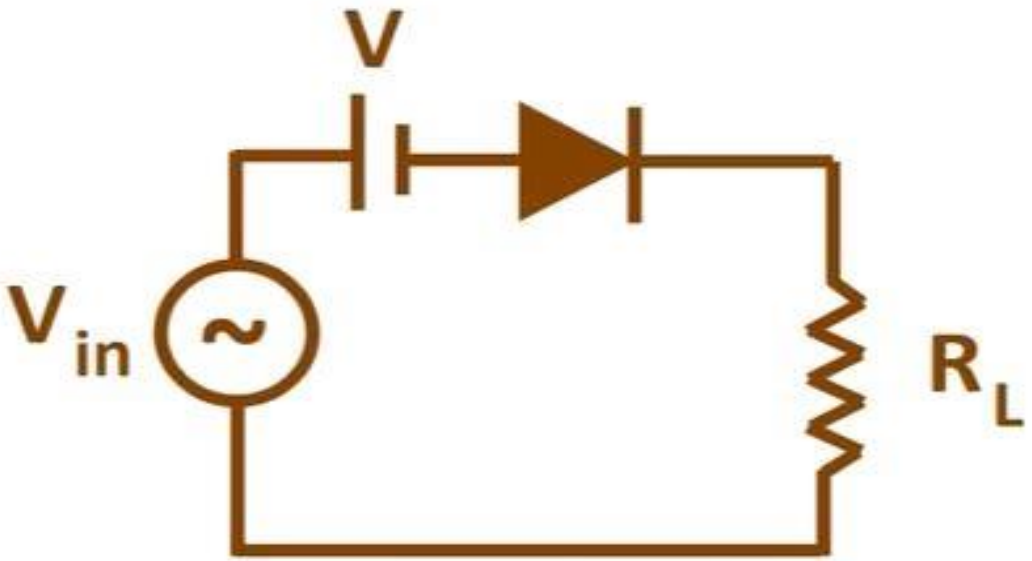


ADDITIONAL CIRCUITS & PROBLEMS



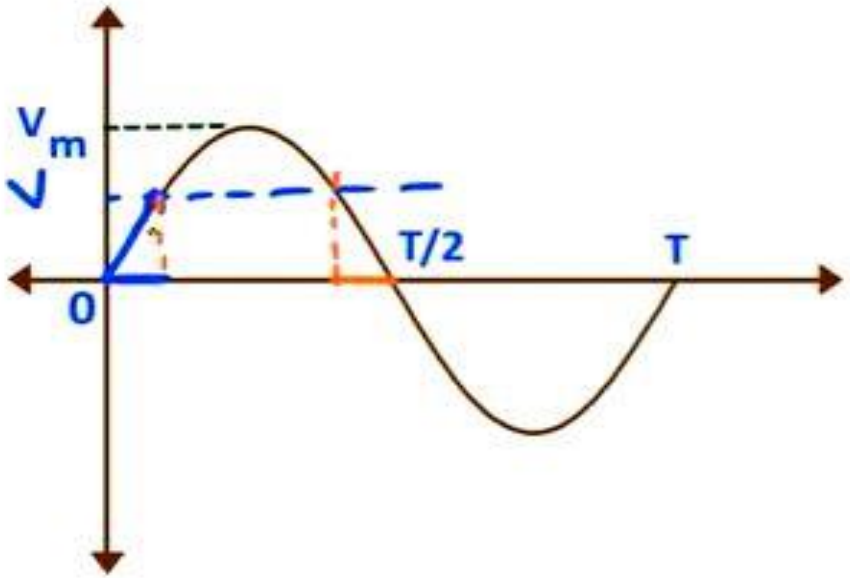


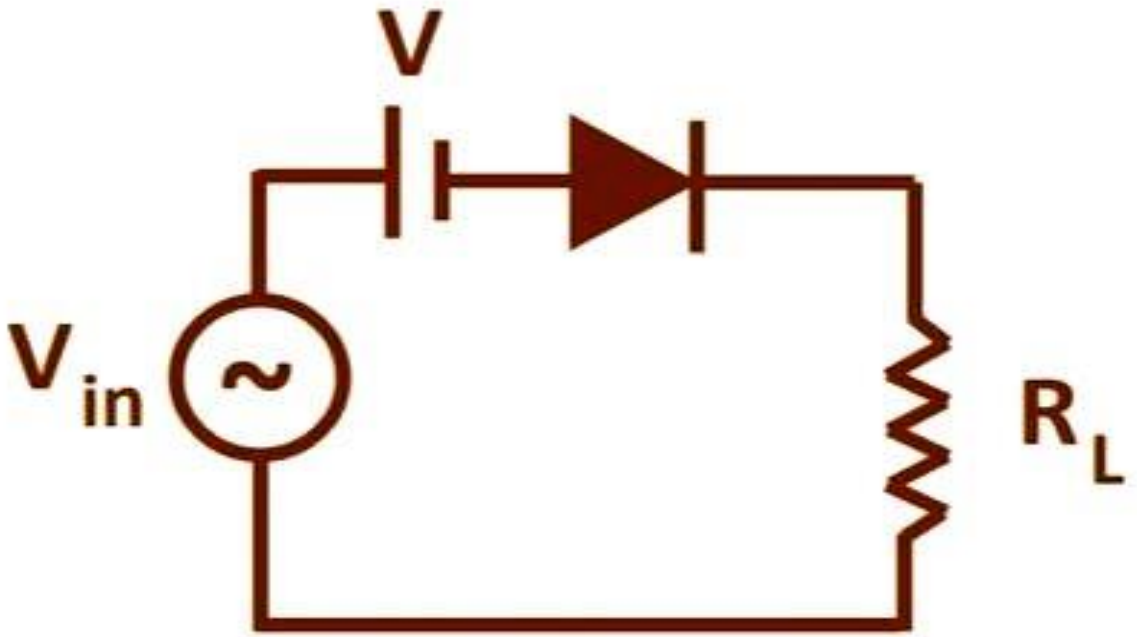




$V_{in} - V > 0$

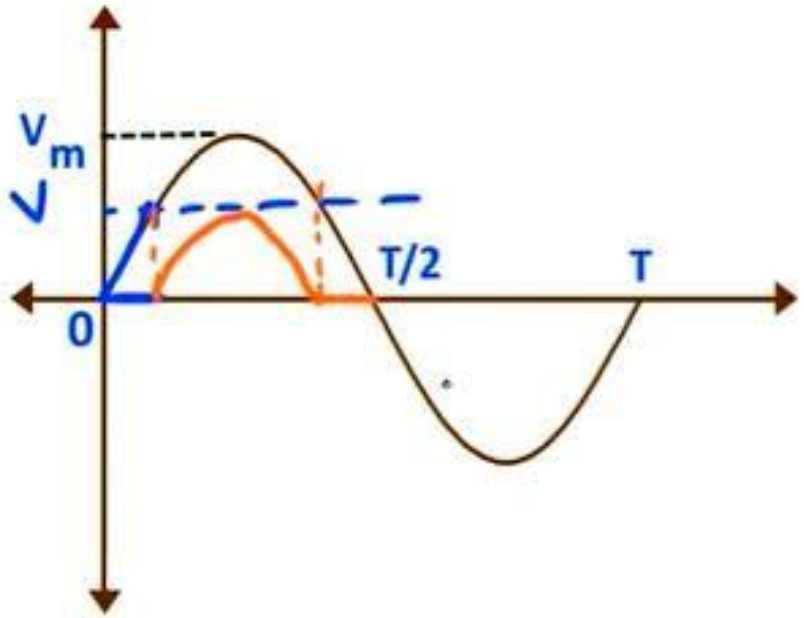
$\Rightarrow V_{in} > V$

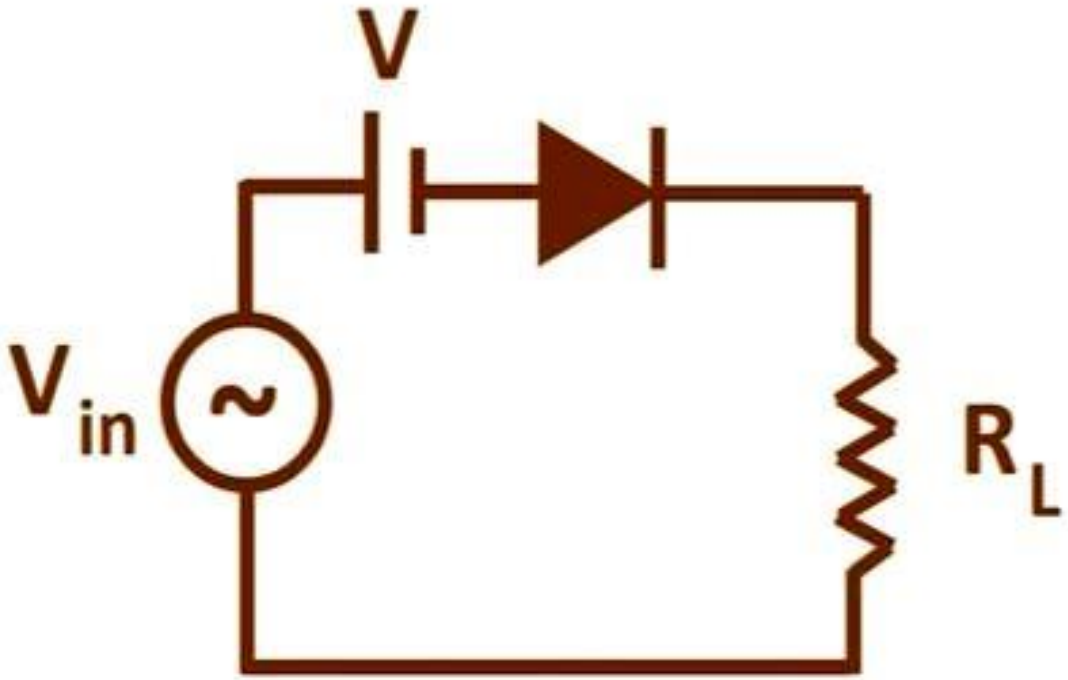




$v_{in} - V > 0$

$\Rightarrow v_{in} > V$



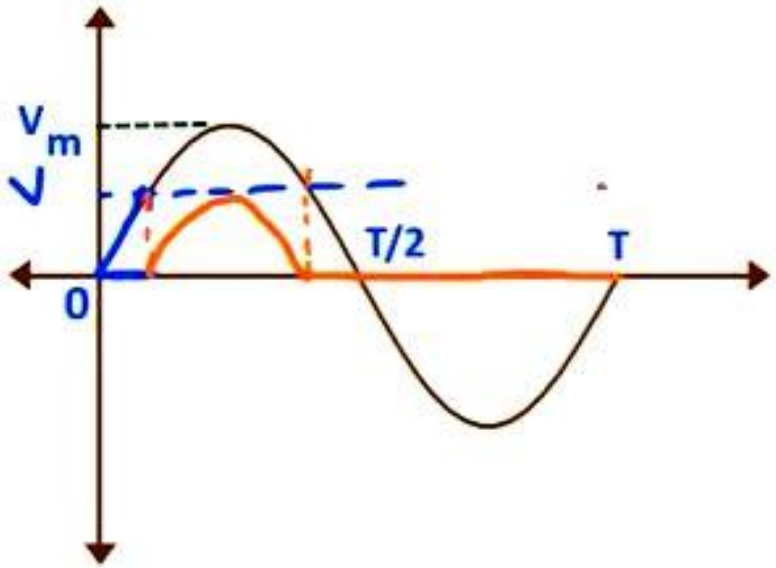


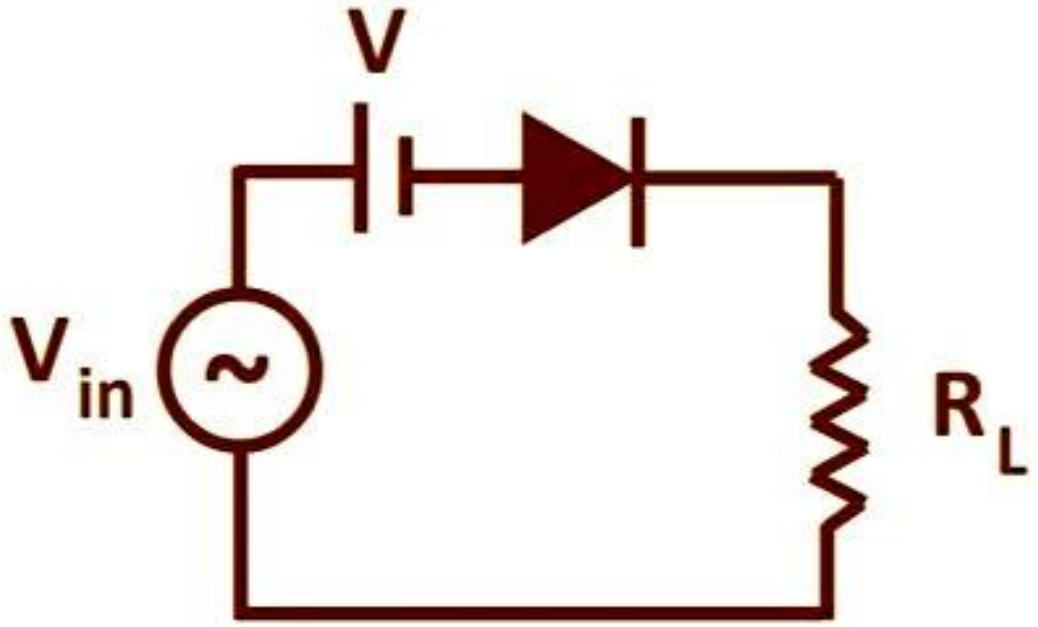
$V_m - V$

$V_{in} - V > 0$

$\Rightarrow V_{in} > V$

$V_{in} - V$



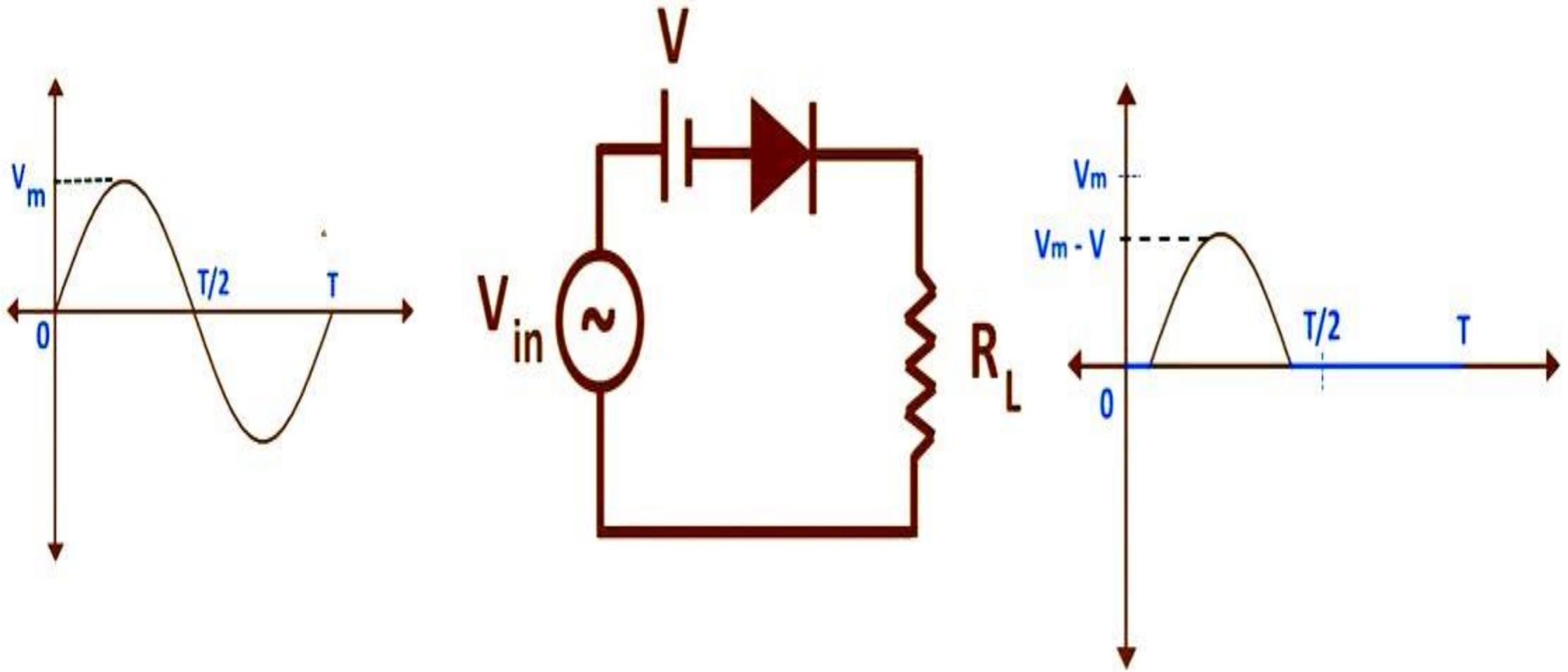


$V_m - V$

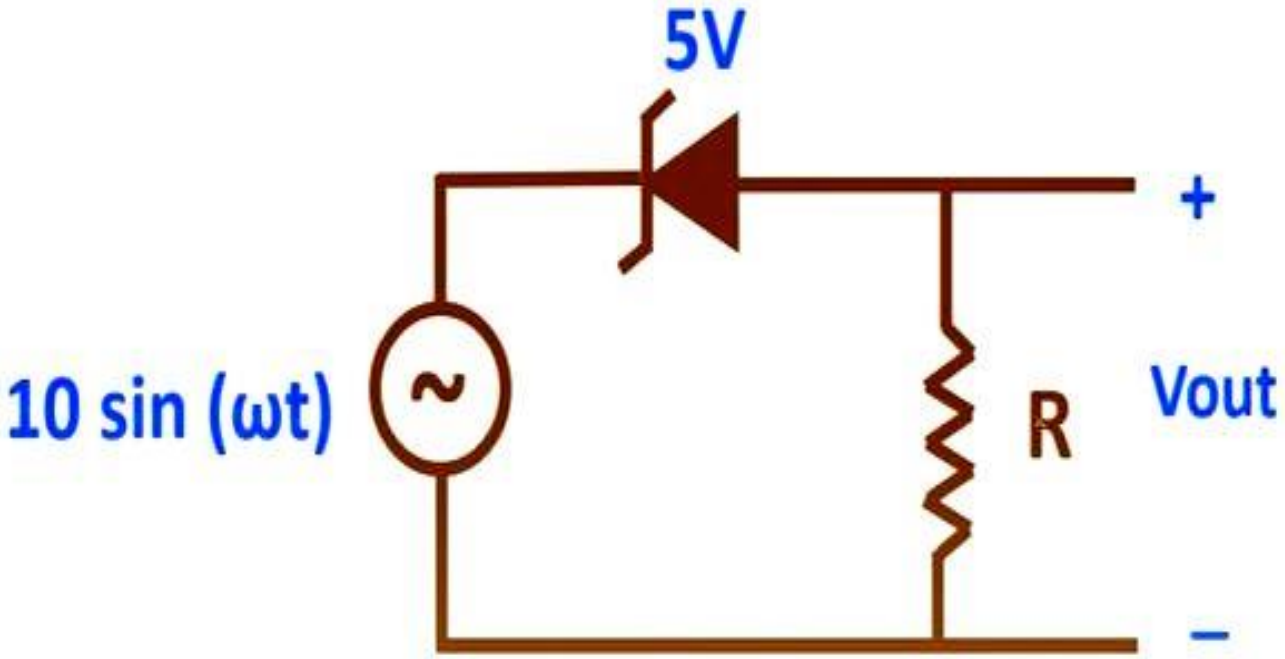
$V_{in} - V > 0$

$\Rightarrow V_{in} > V$

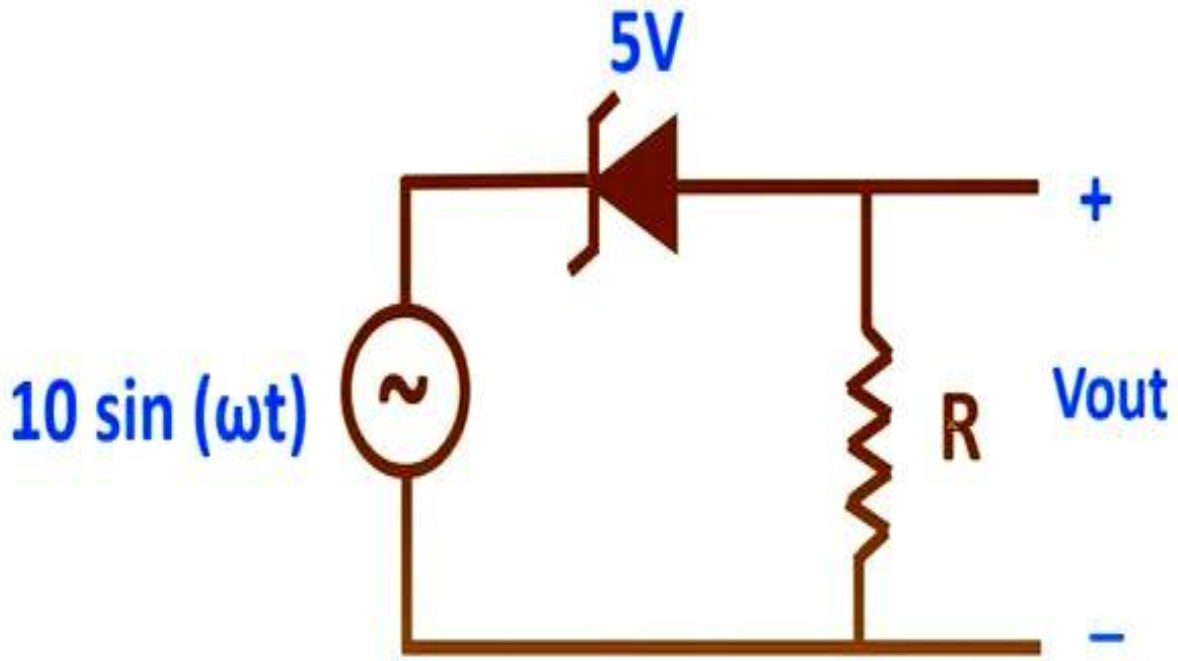
$V_{in} - V$


V
V_m
T/2
T
0
V_{in}
~
R_L
V_m
$V_m - V$
T/2
T
0

For the given circuit, assume that the Zener diode is ideal with breakdown voltage of 5V. Find the output waveform across the resistor R.



For the given circuit, assume that the Zener diode is ideal with breakdown voltage of 5V. Find the output waveform across the resistor R.



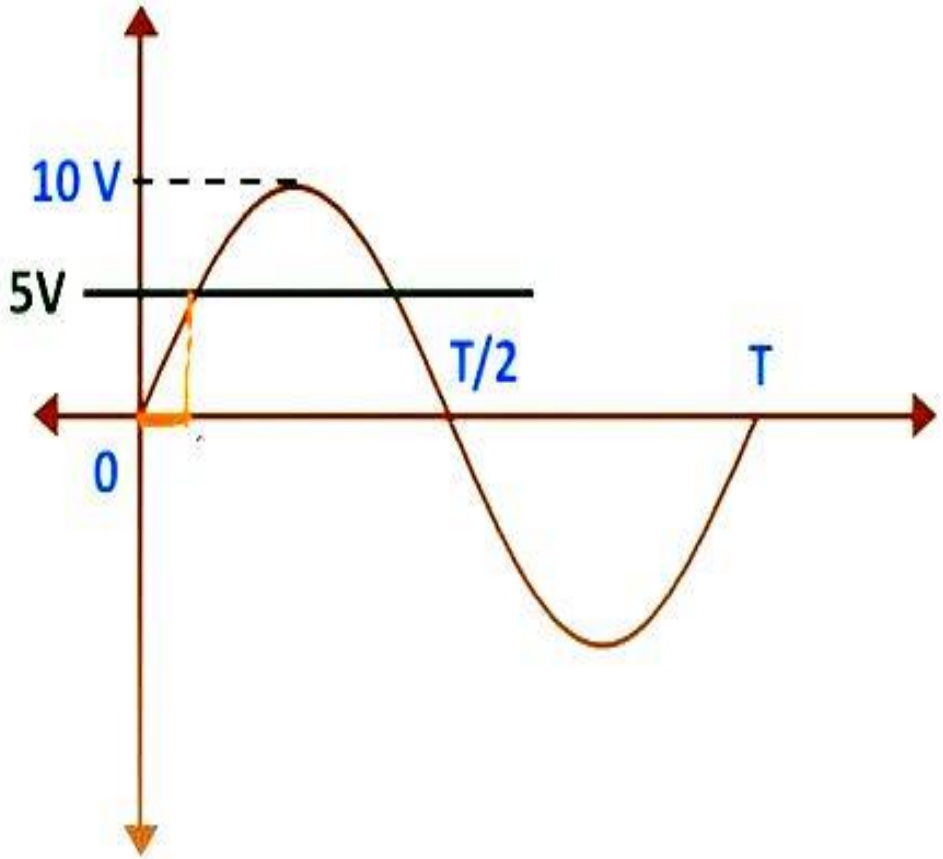
REVERSE BIASED

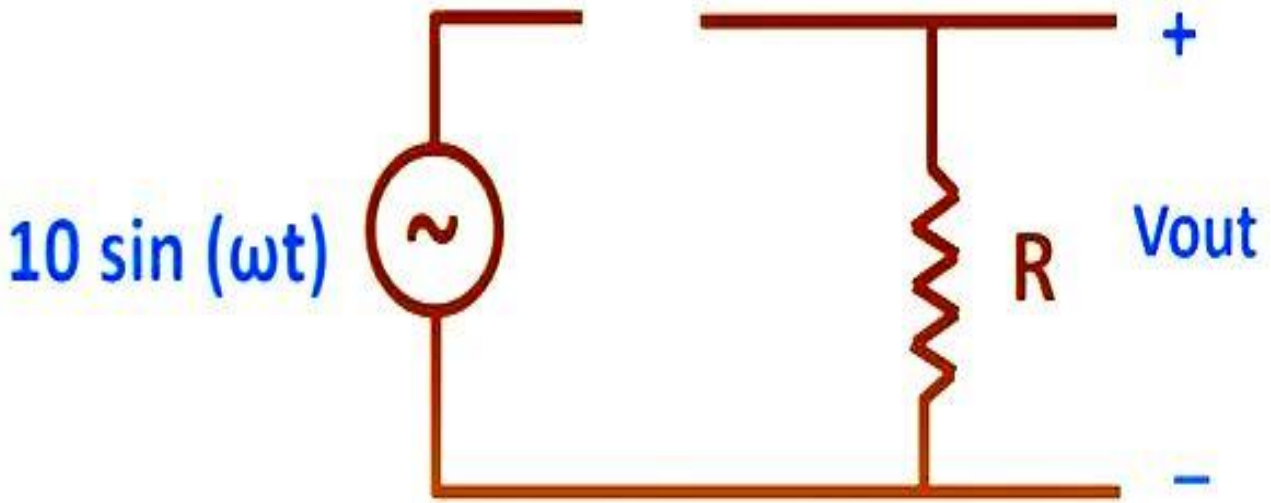
- Vin < Vz -- Open circuited
- Vin > Vz – Act as Voltage Source (Vz)

FORWARD BIASED

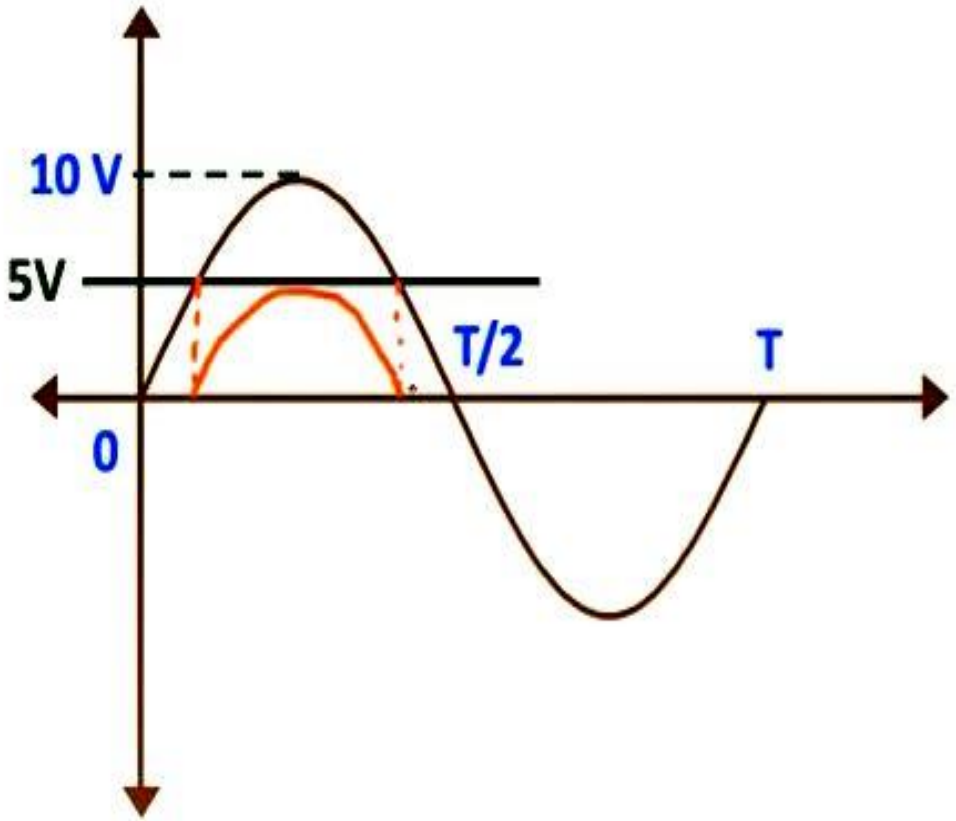
- Act as short circuited normal diode

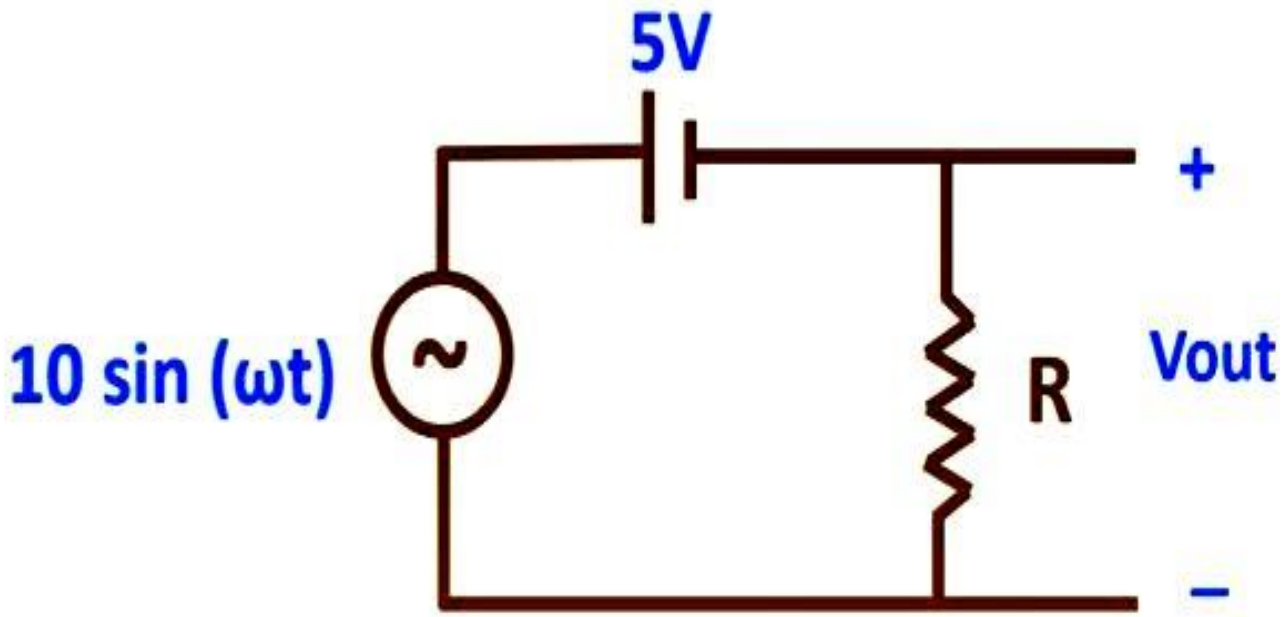
Vin < 5V





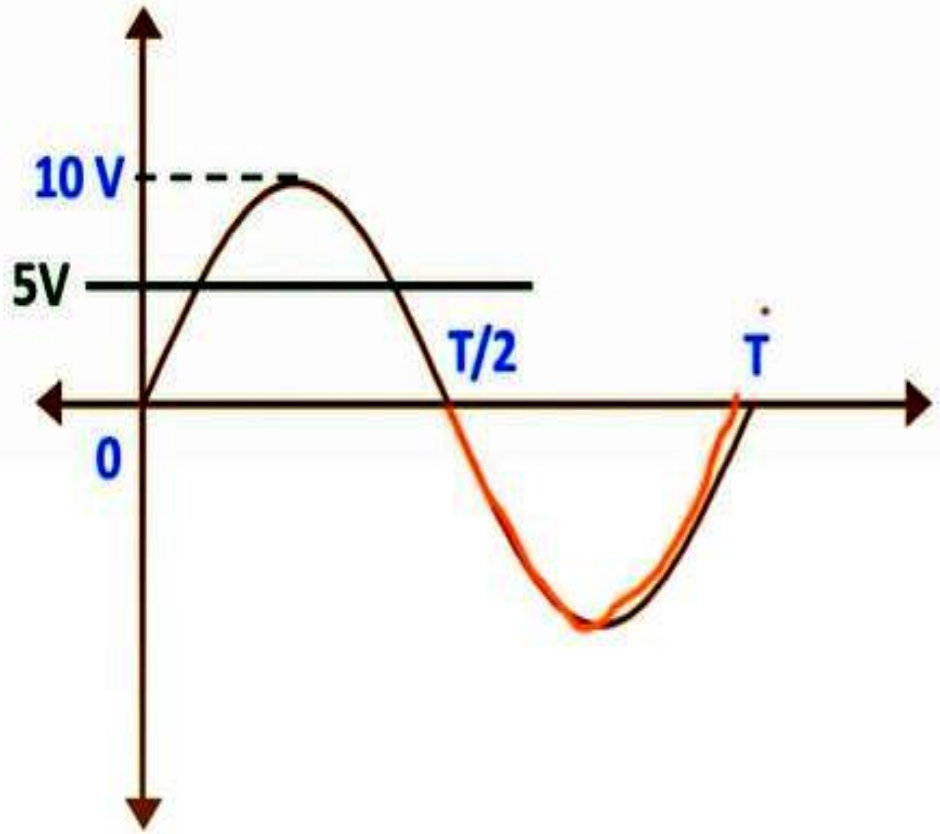
Vin > 5V

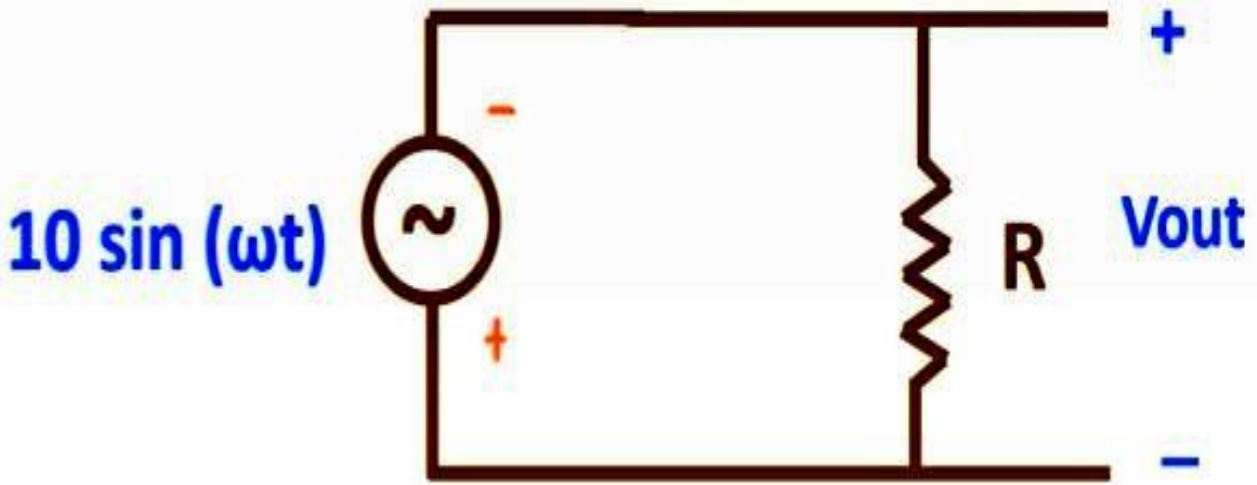


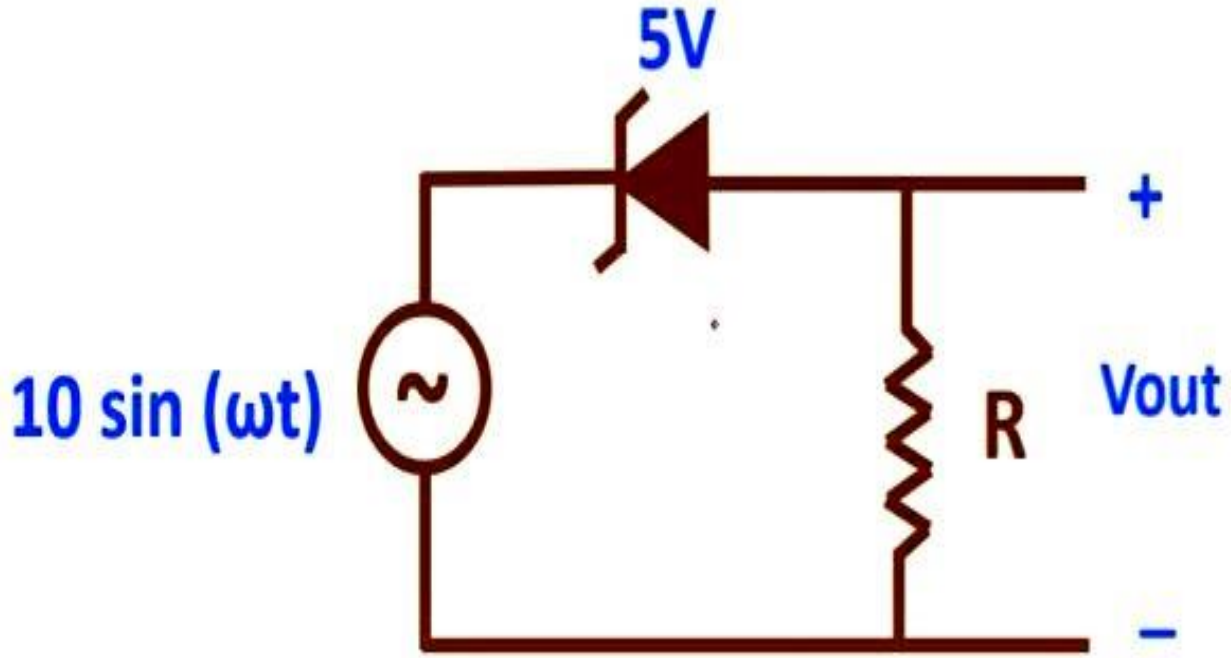


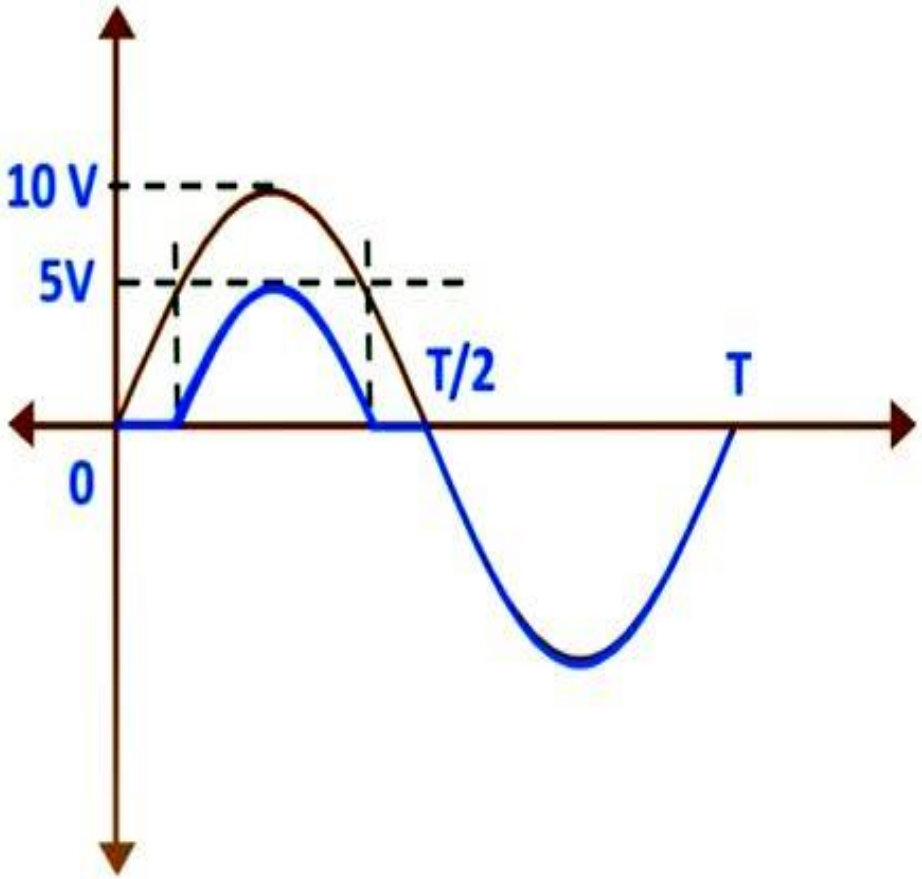
Vin - 5

Vin < 0V

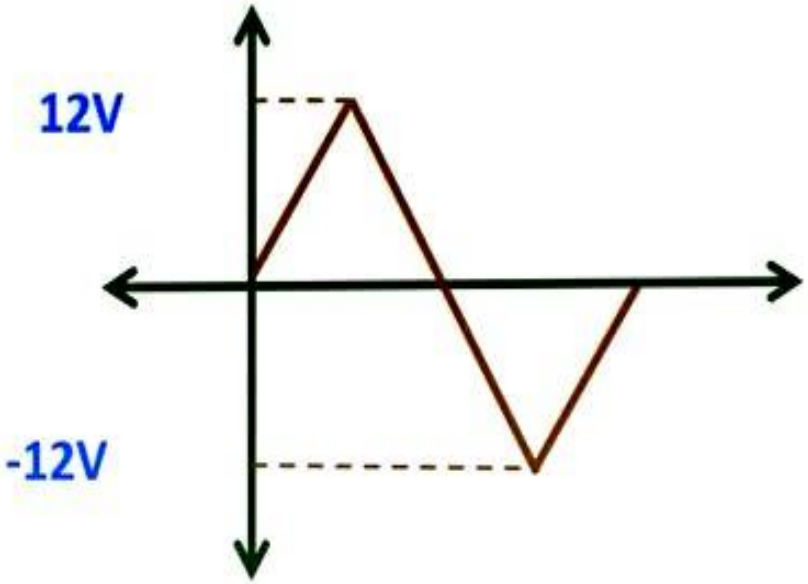


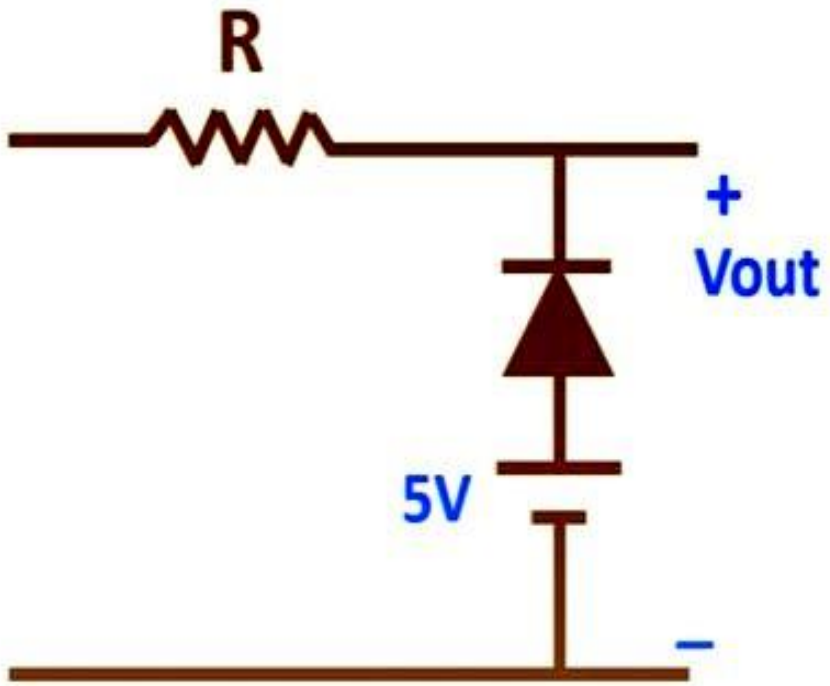


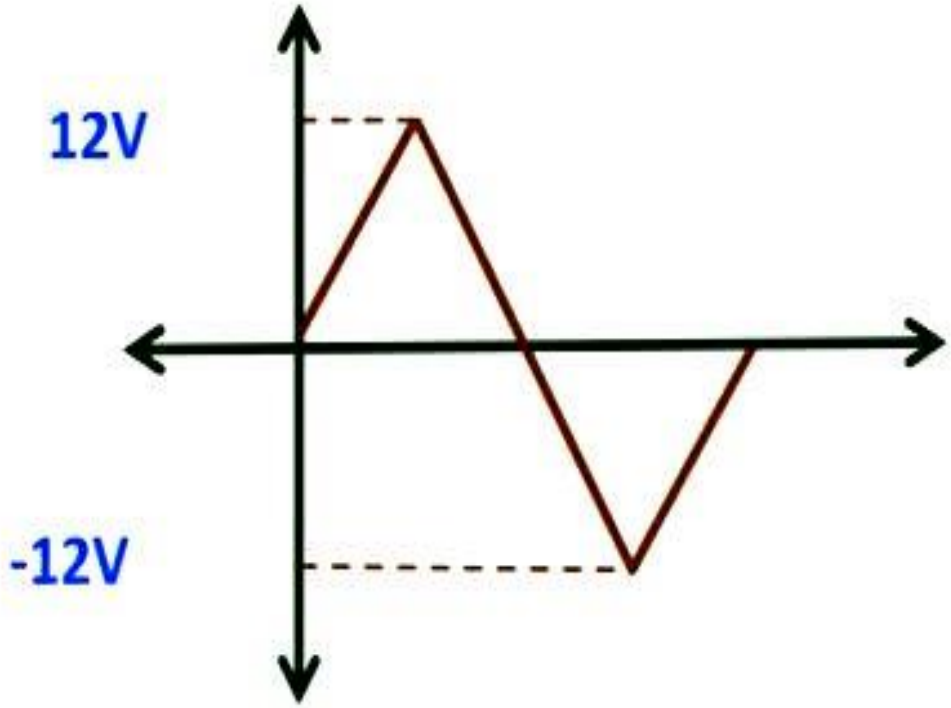

5V
10 sin (ωt)
R
Vout
+
–

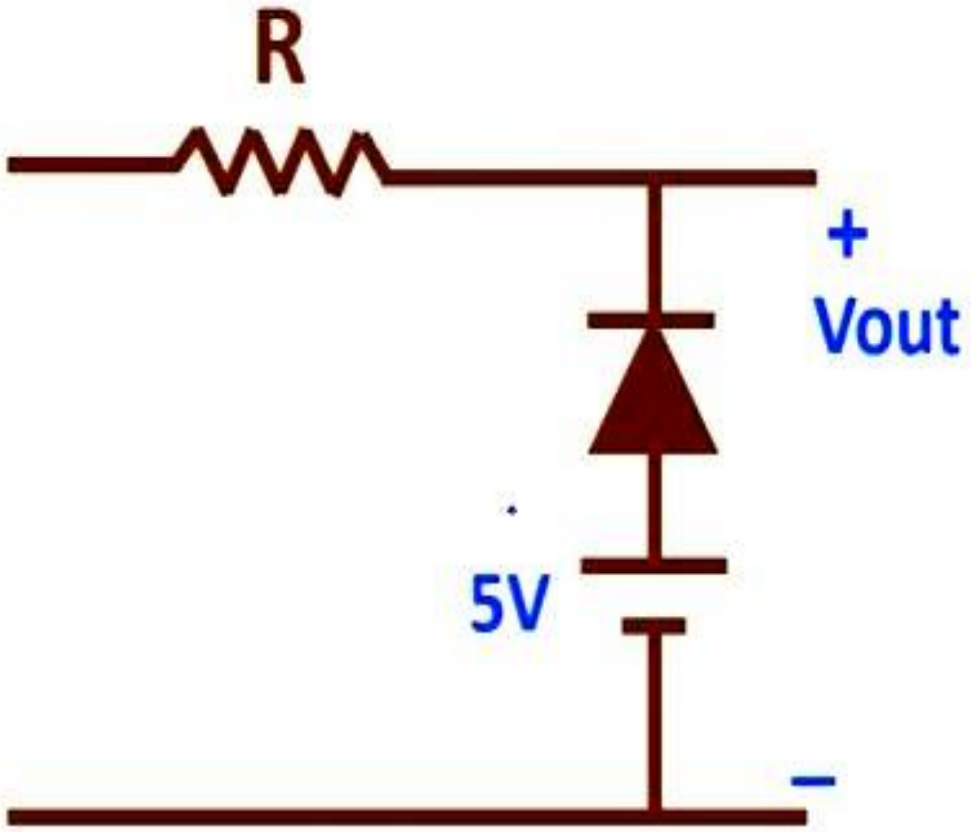

10 V
5V
0
T/2
T

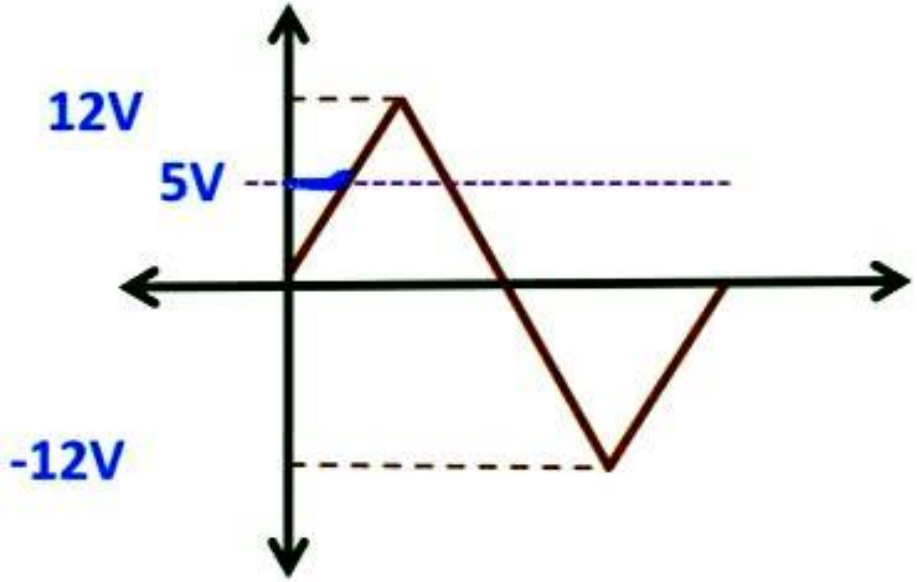
For the given circuit, assume that the diode is ideal diode. Find the output waveform of the circuit.

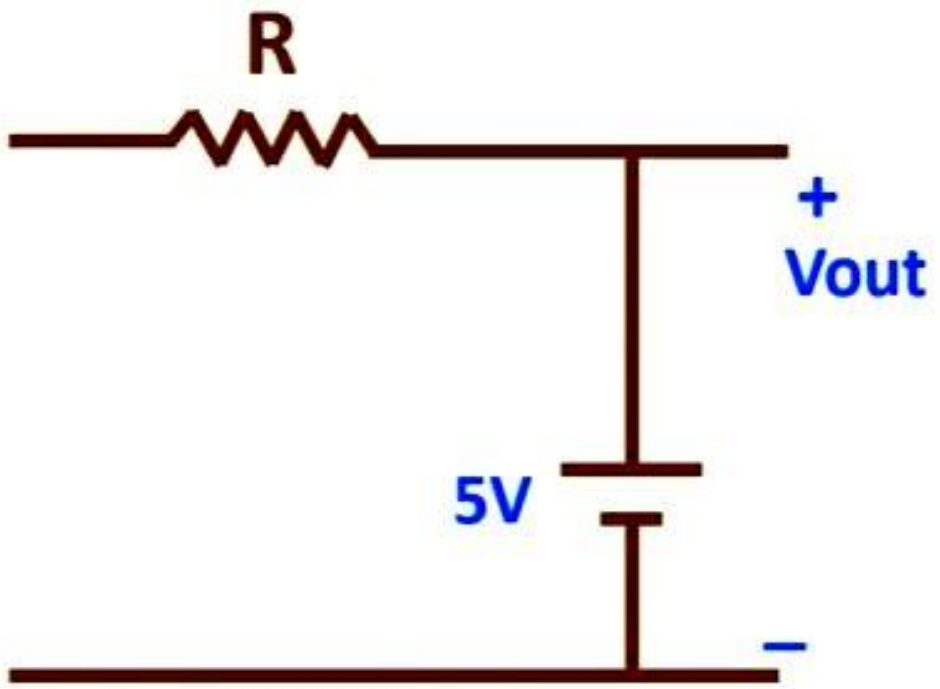




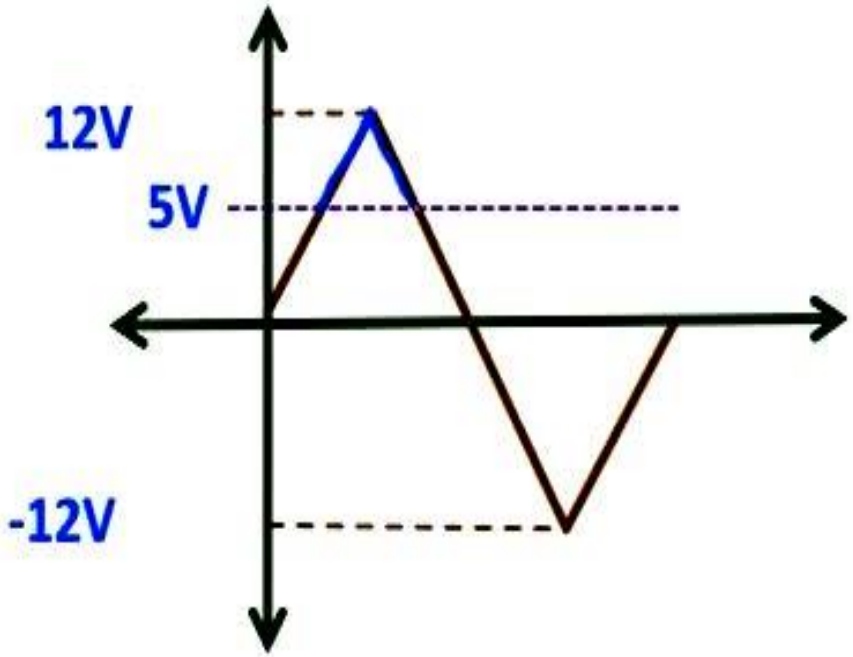

12V
-12V

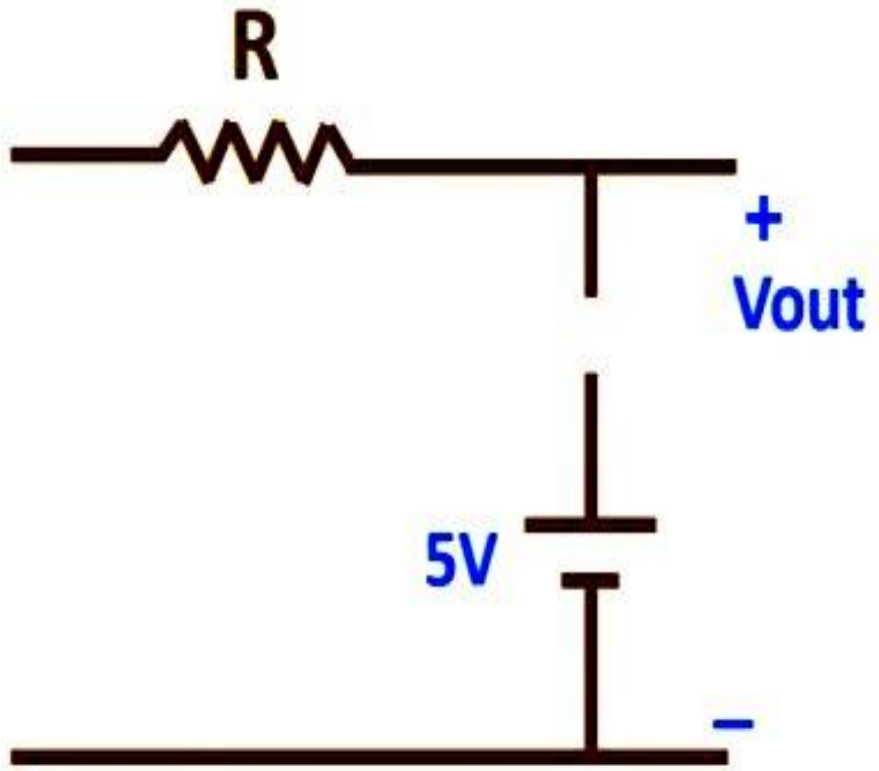

R
+
Vout
5V
–



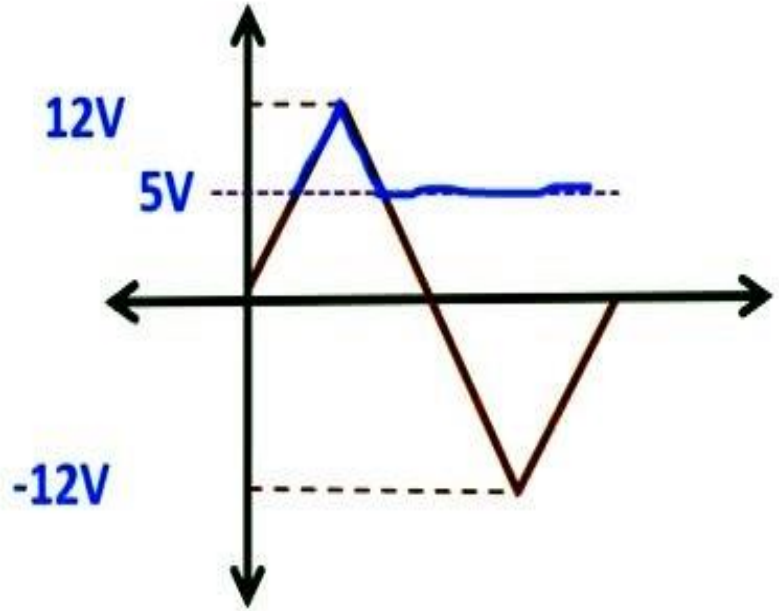


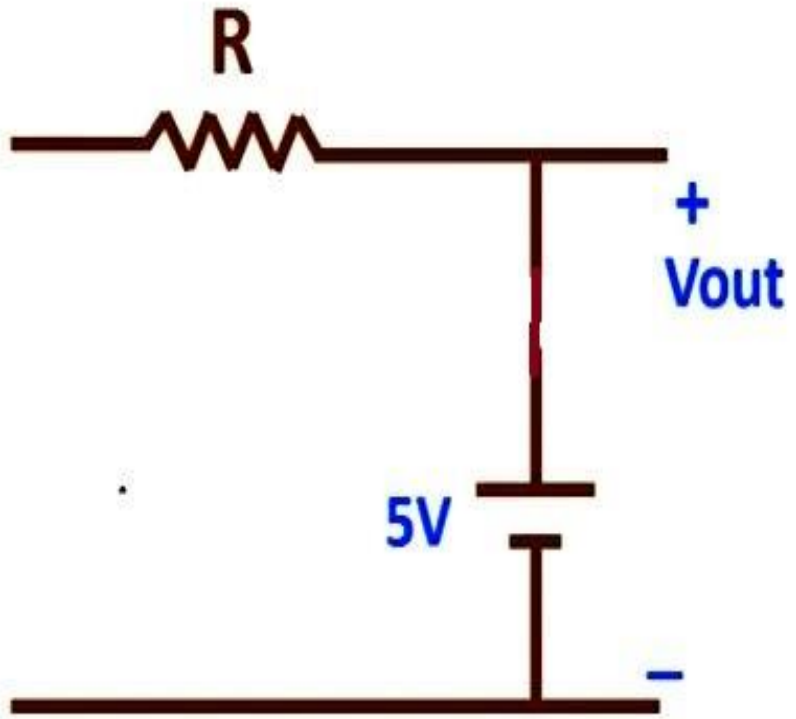
Vin < 5V



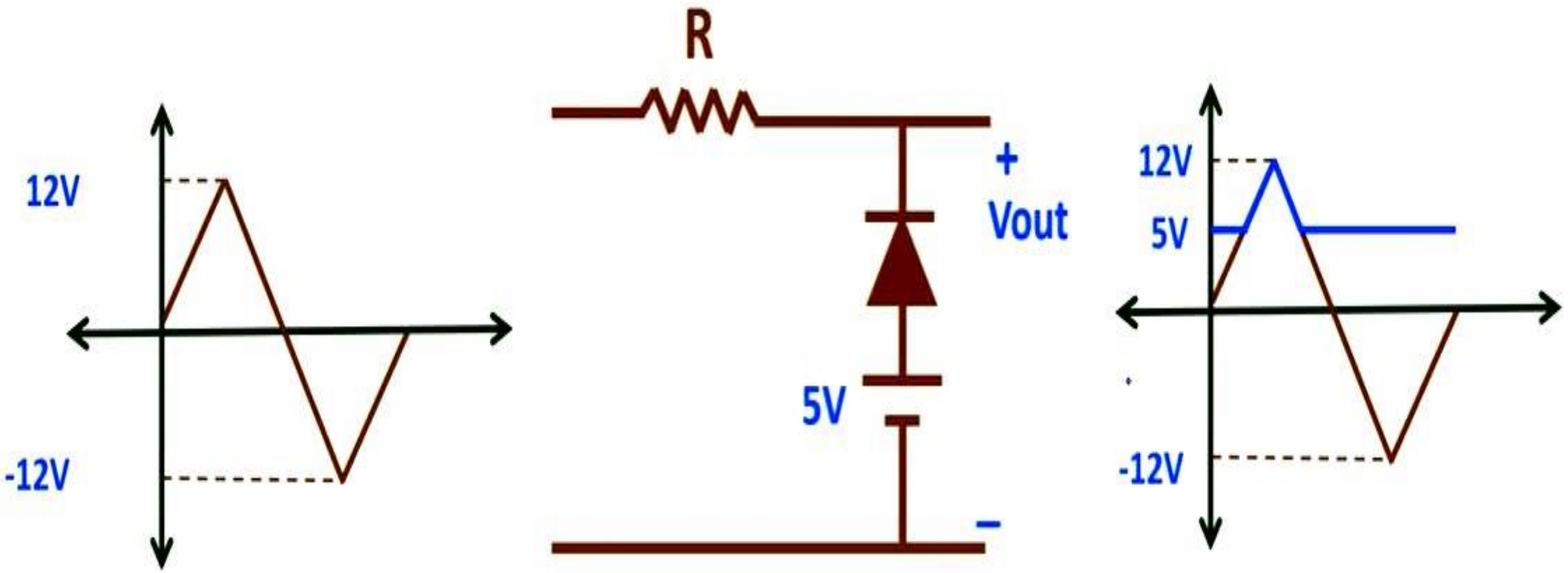


Vin > 5V





Vin < 5V


12V
-12V
R
+
Vout
5V
−
12V
5V
-12V