# Clamper Circuit

BASIC ELECTRONICS

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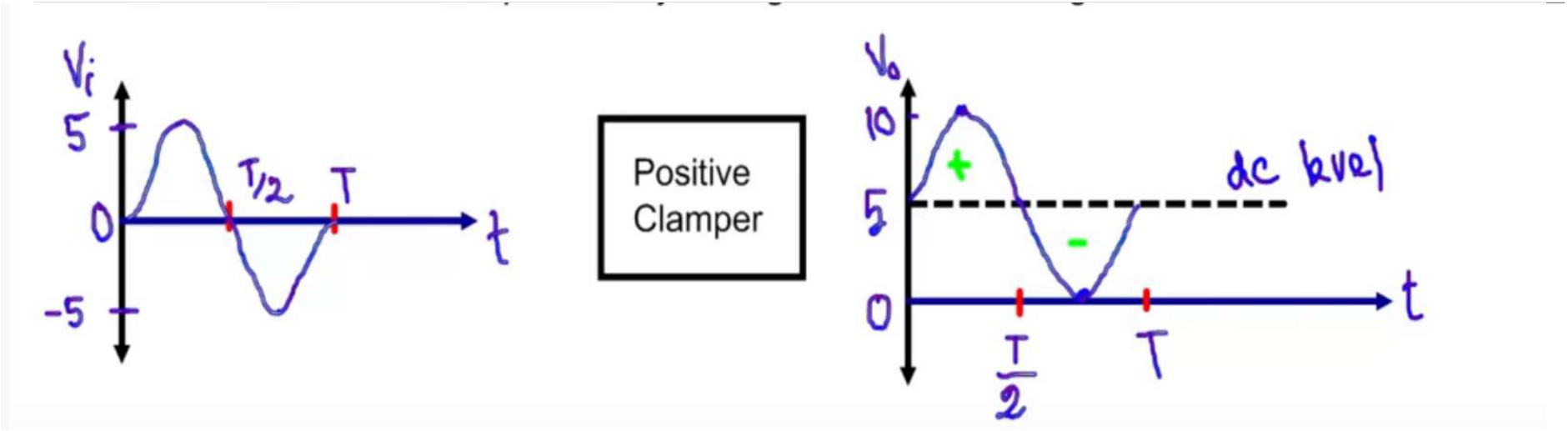
# Clamper Circuit

- Consists of diode, resistor and capacitor.
- Shifts an AC signal into a different DC level.
- Does change the DC level of the signal to the desired level without changing the shape of the signal.
- Further shift in DC level is possible by adding an external bias voltage.
- The basic difference between the clipper and clamper is that the clipper removes the unwanted portion of the input signal whereas the clamper moves the input signal upwards or downwards.

# Positive Clamper Circuit




Positive clamper lift the input wave upward so that negative peak touches ground or zero level or horizontal axis.
A positive clamper shifts its dc level is upward direction.

# Working Principle of Positive Clamper Circuit

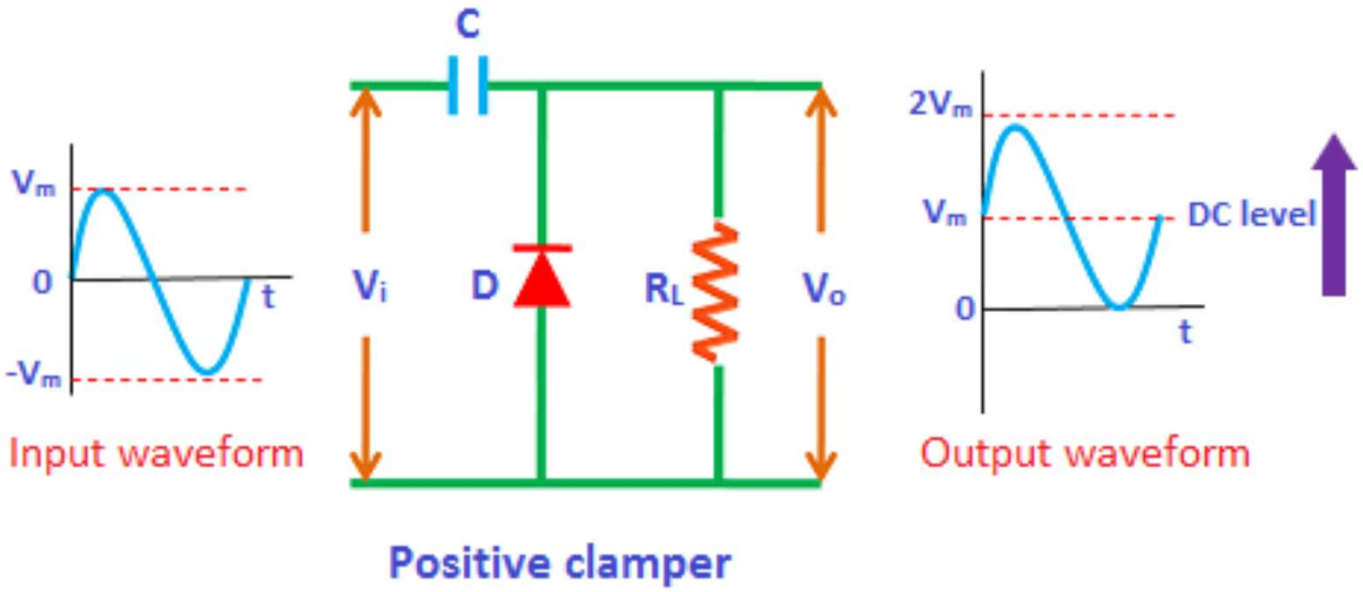



Figure 1

# Explanation: Figure 1

**During positive half cycle:**

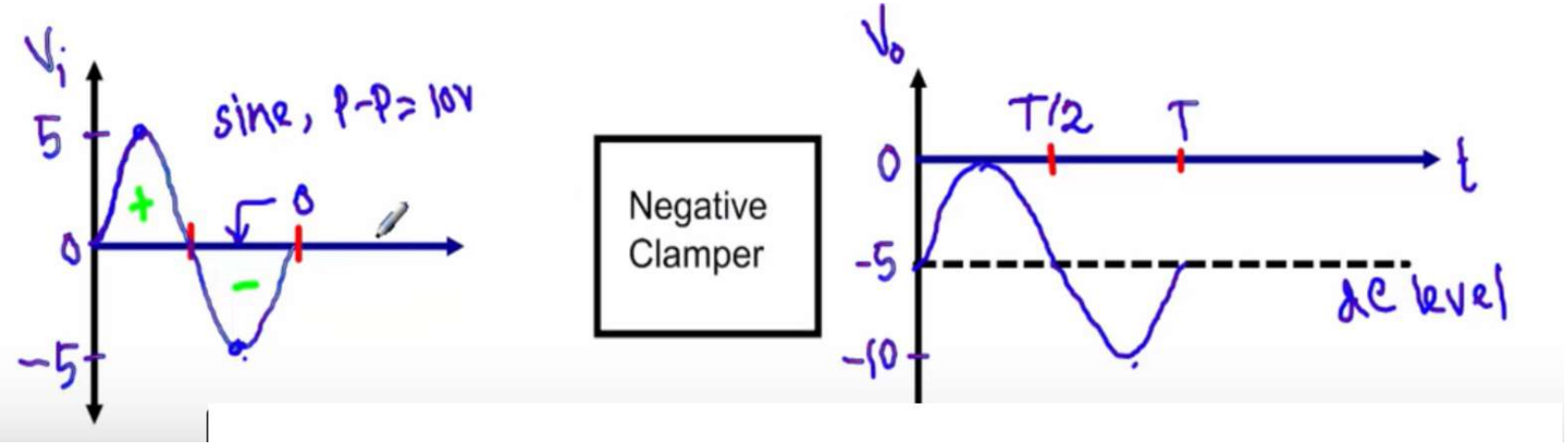
- During the positive half cycle of the input AC signal, the diode is reverse biased and hence the signal appears at the output. In reverse biased condition, the diode does not allow electric current through it. So the input current directly flows towards the output.
- When the positive half cycle begins, the diode is in the non-conducting state and the charge stored in the capacitor is discharged (released). Therefore, the voltage appeared at the output is equal to the sum of the voltage stored in the capacitor ($V_m$) and the input voltage ($V_m$) { I.e. $V_o = V_m + V_m = 2V_m$} which have the same polarity with each other. As a result, the signal shifted upwards.
- The peak to peak amplitude of the input signal is $2V_m$, similarly the peak to peak amplitude of the output signal is also $2V_m$. Therefore, the total swing of the output is same as the total swing of the input.
- The basic difference between the clipper and clamper is that the clipper removes the unwanted portion of the input signal whereas the clamper moves the input signal upwards or downwards.

# Explanation: Figure 1

**During negative half cycle:**

- During the negative half cycle of the input AC signal, the diode is forward biased and hence no signal appears at the output.
- In forward biased condition, the diode allows electric current through it.
- This current will flows to the capacitor and charges it to the peak value of input voltage $V_m$.
- The capacitor charged in inverse polarity (positive) with the input voltage.
- As input current or voltage decreases after attaining its maximum value $-V_m$, the capacitor holds the charge until the diode remains forward biased.

# Negative Clamper Circuit




Negative clampers push the output wave downwards so that positive peak touches ground or zero level or horizontal axis.

A Negative clamper shifts its dc level is negative direction.

# Working Principle of Negative Clamper Circuit

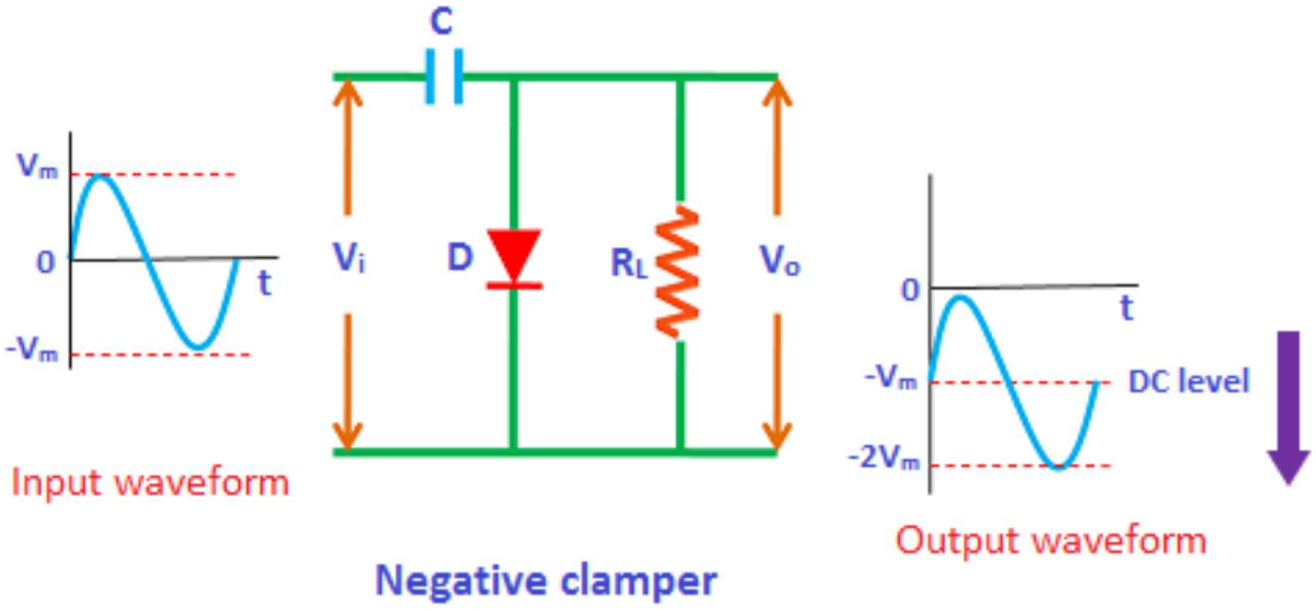



Figure 2

# Explanation: Figure 2

**During positive half cycle:**

- During the positive half cycle of the input AC signal, the diode is forward biased and hence no signal appears at the output.
- In forward biased condition, the diode allows electric current through it.
- This current will flows to the capacitor and charges it to the peak value of input voltage in inverse polarity $-V_m$.
- As input current or voltage decreases after attaining its maximum value $V_m$, the capacitor holds the charge until the diode remains forward biased.

# Explanation: Figure 2

**During negative half cycle:**

- During the negative half cycle of the input AC signal, the diode is reverse biased and hence the signal appears at the output.
- In reverse biased condition, the diode does not allow electric current through it. So the input current directly flows towards the output.
- When the negative half cycle begins, the diode is in the non-conducting state and the charge stored in the capacitor is discharged (released).
- Therefore, the voltage appeared at the output is equal to the sum of the voltage stored in the capacitor ($-V_m$) and the input voltage ($-V_m$) {I.e. $V_o = -V_m - V_m = -2V_m$} which have the same polarity with each other. As a result, the signal shifted downwards.

# Biased Clamper Circuit

An extra element called DC battery is introduced in the  clamper circuit.

This can be classified into,

-Positive clamper with positive bias

- Positive clamper with negative bias

-Negative clamper with positive bias

-Negative clamper with negative bias

# Positive clamper with positive bias

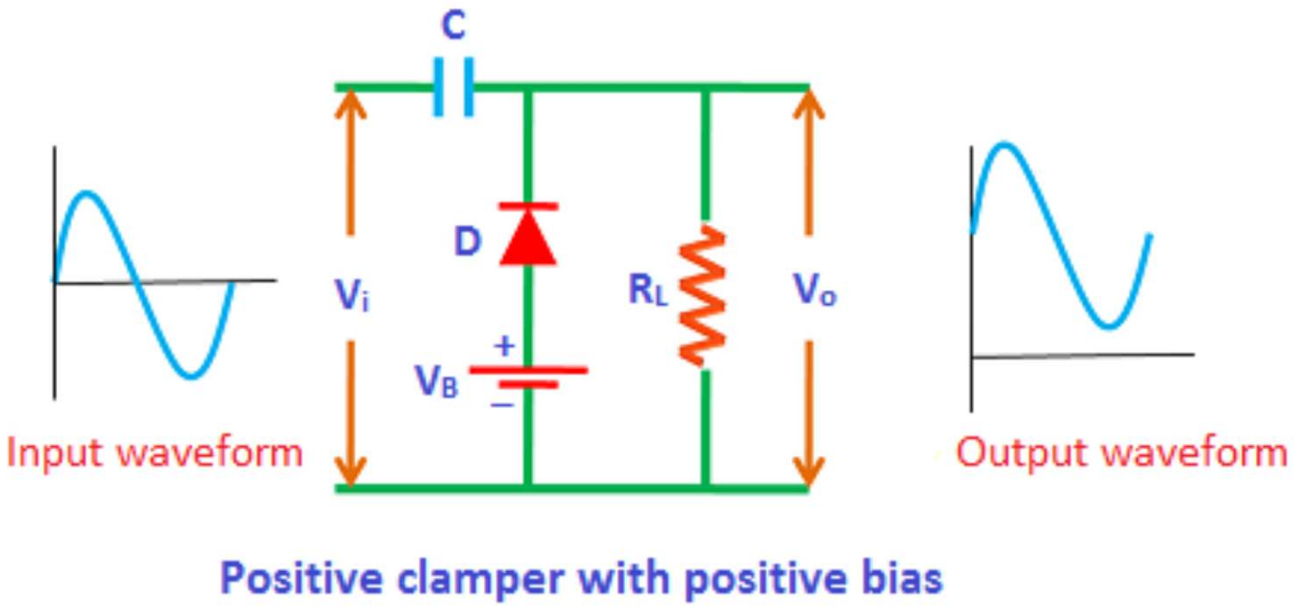



Figure 3

# Explanation: Figure 3

**During positive half cycle:**

- During the positive half cycle, the battery voltage forward biases the diode when the input supply voltage is less than the battery voltage.
- This current or voltage will flows to the capacitor and charges it.
- When the input supply voltage becomes greater than the battery voltage then the diode stops allowing electric current through it because the diode becomes reverse biased.

# Explanation: Figure 3

**During negative half cycle:**

- During the negative half cycle, the diode is forward biased by both input supply voltage and battery voltage.
- So the diode allows electric current. This current will flows to the capacitor and charges it.

# Positive clamper with negative bias

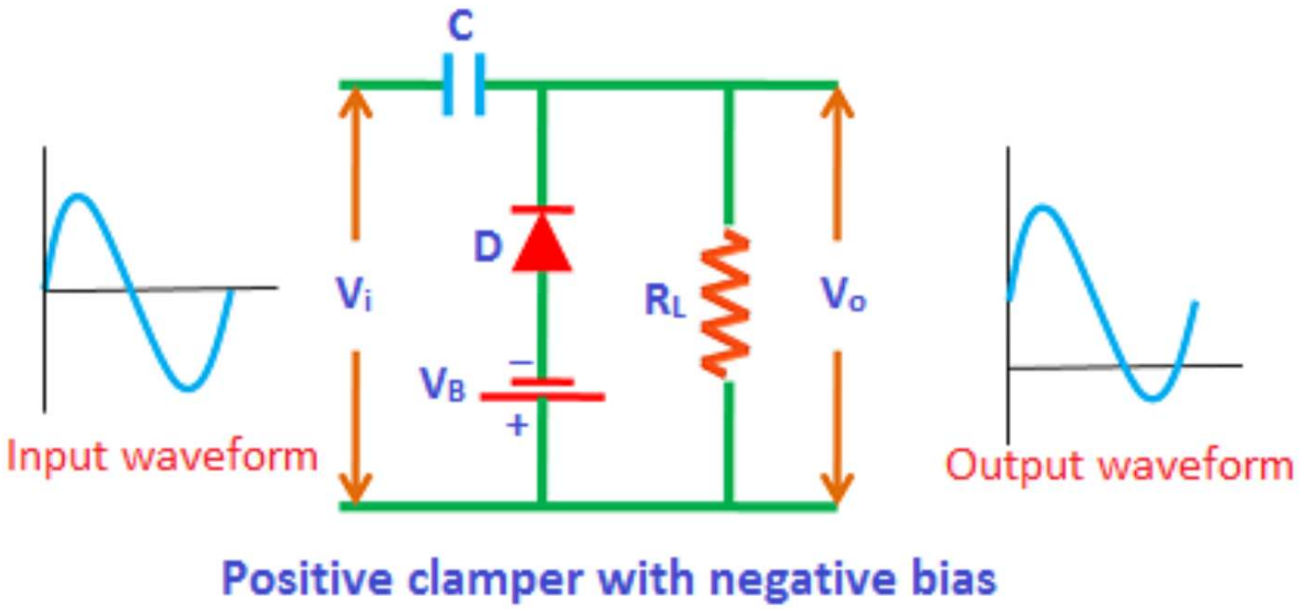



Figure 4

# Explanation: Figure 4

**During positive half cycle:**

- During the positive half cycle, the diode is reverse biased by both input supply voltage and the battery voltage.
- As a result, the signal appears at the output. The signal appeared at the output is equal to the sum of the input voltage and capacitor voltage.

# Explanation: Figure 4

**During negative half cycle:**

- During the negative half cycle, the battery voltage reverse biases the diode when the input supply voltage is less than the battery voltage. As a result, the signal appears at the output.

- When the input supply voltage becomes greater than the battery voltage, the diode is forward biased by the input supply voltage and hence allows electric current through it. This current will flows to the capacitor and charges it.

# Negative clamper with positive bias

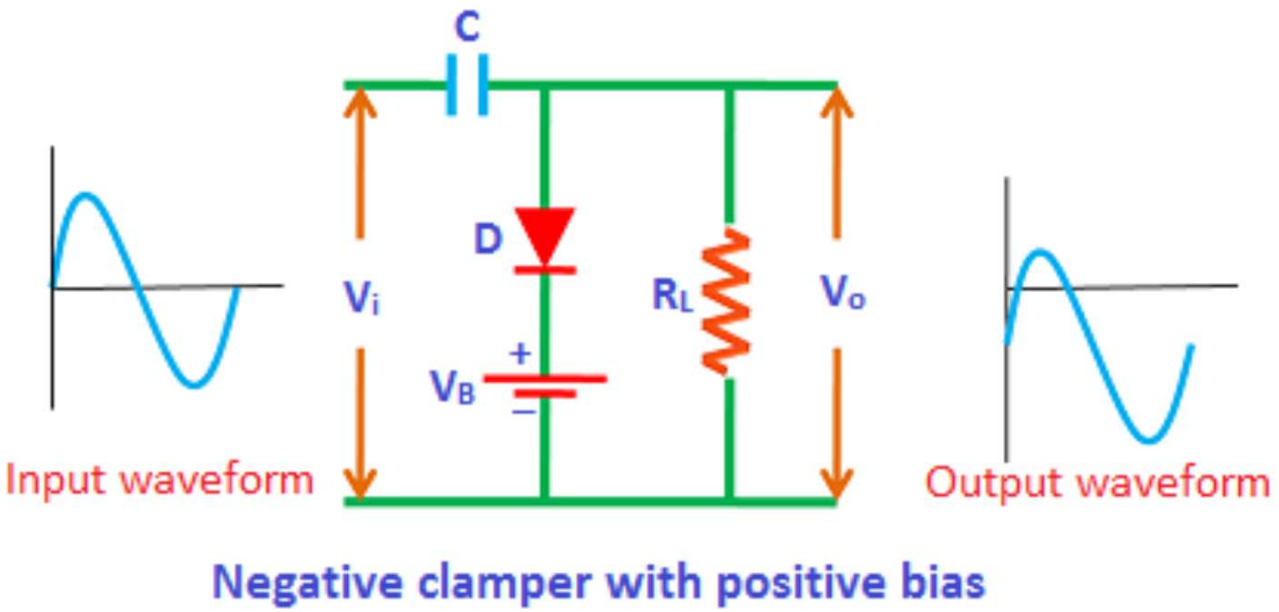



Figure 5

# Explanation: Figure 5

**During positive half cycle:**

- During the positive half cycle, the battery voltage reverse biases the diode when the input supply voltage is less than the battery voltage.
- When the input supply voltage becomes greater than the battery voltage, the diode is forward biased by the input supply voltage and hence allows electric current through it.
- This current will flows to the capacitor and charges it.

# Explanation: Figure 5

**During negative half cycle:**

- During the negative half cycle, the diode is reverse biased by both input supply voltage and battery voltage. As a result, the signal appears at the output.

# Negative clamper with negative bias

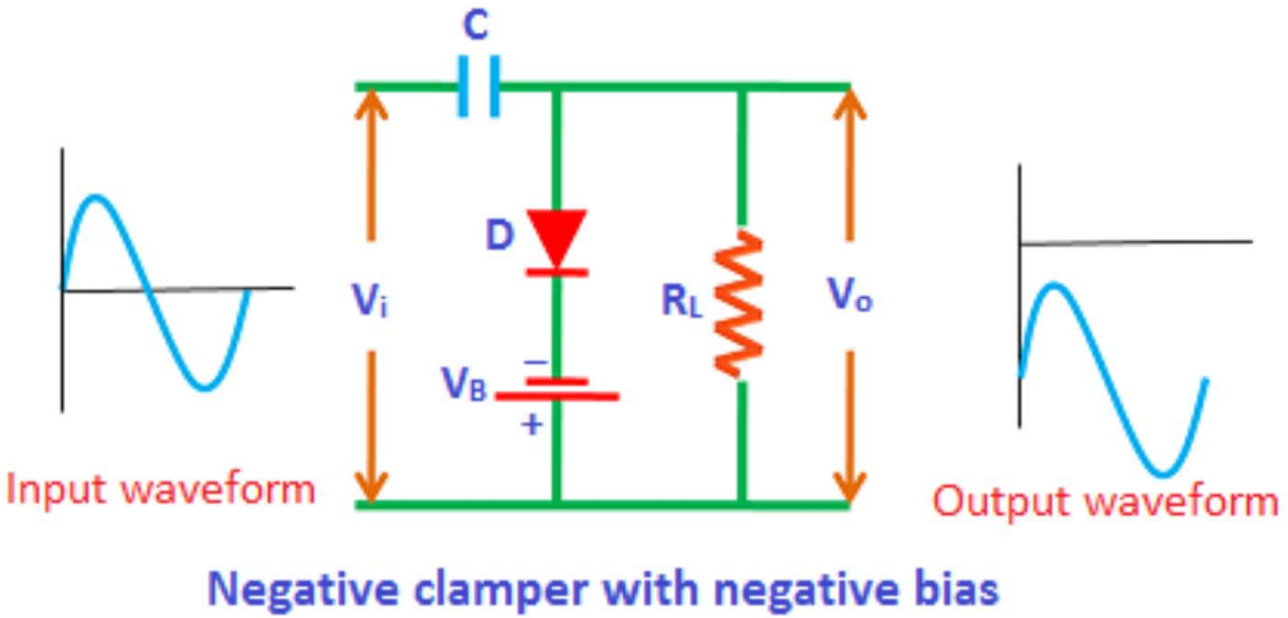



Figure 6

# Explanation: Figure 6

**During positive half cycle:**

- During the positive half cycle, the diode is forward biased by both input supply voltage and battery voltage. As a result, current flows through the capacitor and charges it.

# Explanation: Figure 6

**During negative half cycle:**

- During the negative half cycle, the battery voltage forward biases the diode when the input supply voltage is less than the battery voltage.
- When the input supply voltage becomes greater than the battery voltage, the diode is reverse biased by the input supply voltage and hence signal appears at the output.

# THANK YOU