Programme-	B-TECH
Course -	Basics of Electronics Engineering
Course Code-	ES-211
Sem-	III sem
Year-	2020-21
Unit-	1 (Part-2)
Topic-	Rectifier, Capacitor filter, zener diode,
Sub-Topic-	Half and Full wave Rectifier, Peak inverse voltage, Characteristics of Zener diode, capacitor filter.
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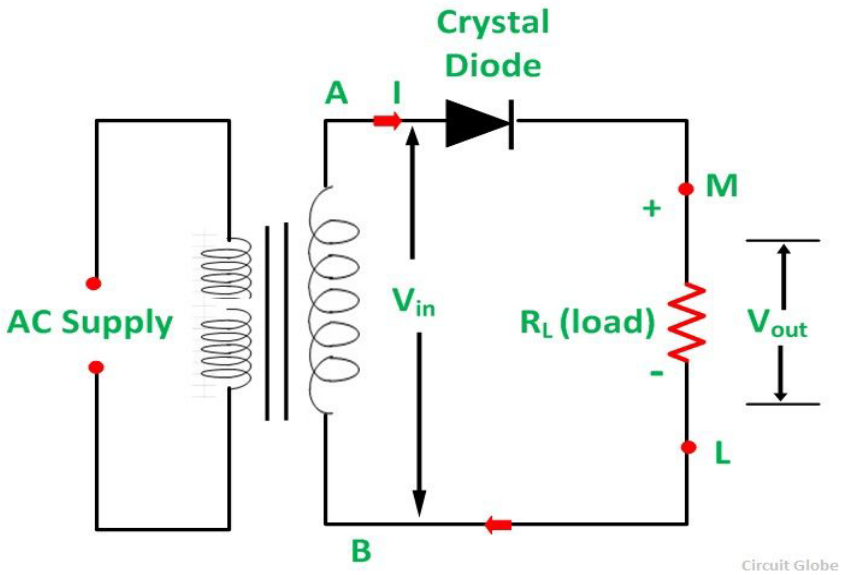
Half Wave and Full Wave Rectifier

In **Half Wave Rectifier**, when AC supply is applied at the input, positive half cycle appears across the load, whereas the negative half cycle is suppressed. This can be done by using the semiconductor PN – junction diode. The diode allows the current to flow only in one direction. Thus, convert the AC voltage into DC voltage.

Circuit Diagram of Half Wave Rectifier

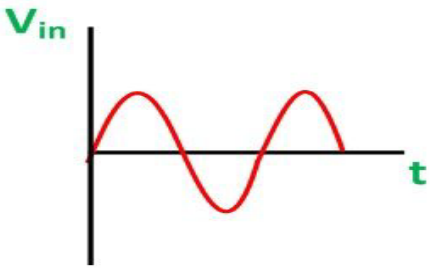
In half wave rectification, only one crystal diode is used. It is connected in the circuit as shown below.



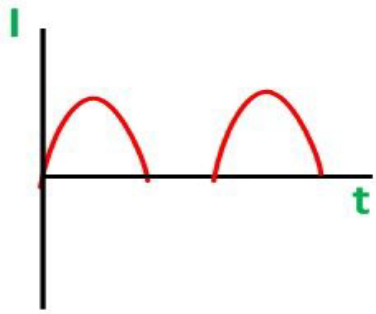
The AC supply to be rectified is generally given through a transformer. The transformer is used to step down or step up the main supply voltage as per the requirement. It also isolates the rectifier from power lines and thus reduces the risk of electric shock.

Operation of Half Wave Rectifier

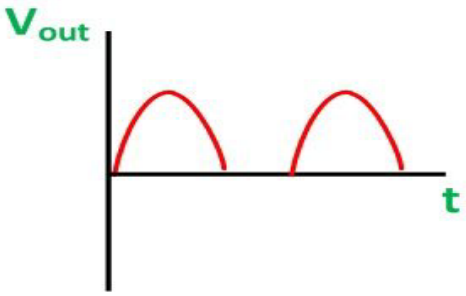
When AC supply is switched ON the alternating voltage (V_{in}) shown in the figure below appears across the terminal AB at the secondary winding.



During the positive half cycle, the terminal A is positive with respect to B and the crystal diode is forward biased. Therefore, it conducts and current flows through the load resistor R_L. This current varies in magnitude as shown in the wave diagram shown below.



Thus, a positive half cycle of the output voltage ($V_{out} = i_{RL}$) appears across the load resistor R_L shown in the figure below.



Peak Inverse Voltage

During the negative half cycle when the diode is reverse biased the maximum value of the voltage coming across the diode is called the peak inverse voltage. As the current flows through the load resistor RL, only in one direction, i.e., from M to L. Hence, a DC output is obtained across RL, which is pulsating in nature.

Disadvantages of the Half Wave Rectifier

- The disadvantages of the half wave rectifier are as follows:-

- The output is low because AC supply delivers power only half of the time.
- The output contains more alternating component (ripples). Therefore, it needs heavy filter circuit to smooth out the output.

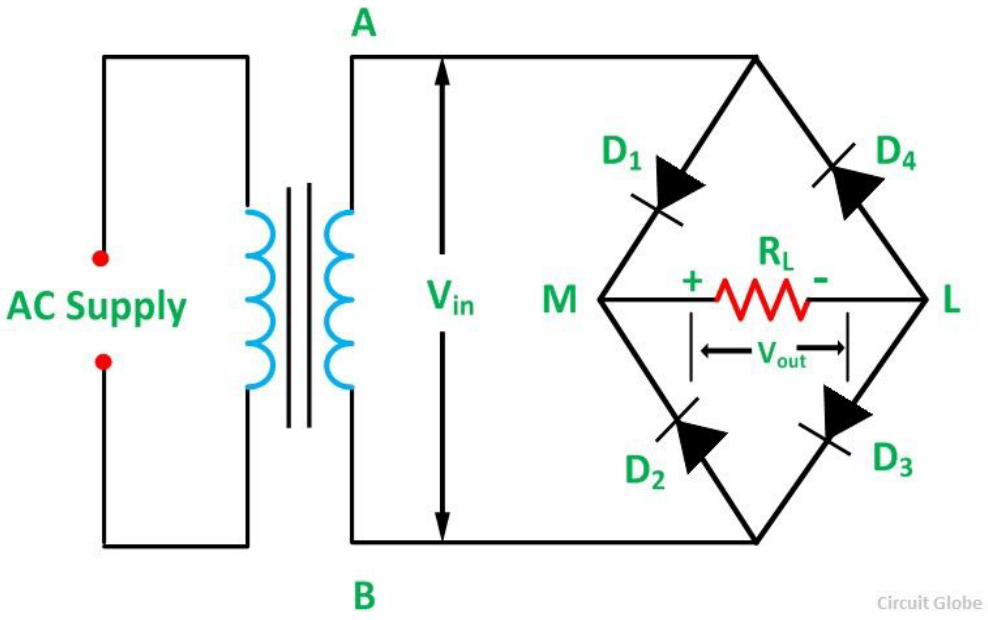
Full Wave Rectifier

In **Full Wave Rectification**, when the AC supply is applied at the input, during both the half cycles (i.e., positive as well as negative) current flows through the load in the same direction. This can be achieved by using two crystal diodes. The two diodes conduct the current alternately.

To obtain the same direction of flow of current in the load resistors R_L during positive as well as the negative half cycle of input, the two circuits are used. They are named as follows:-

- Center tapped full wave rectifier
- Full Wave Bridge Rectifier

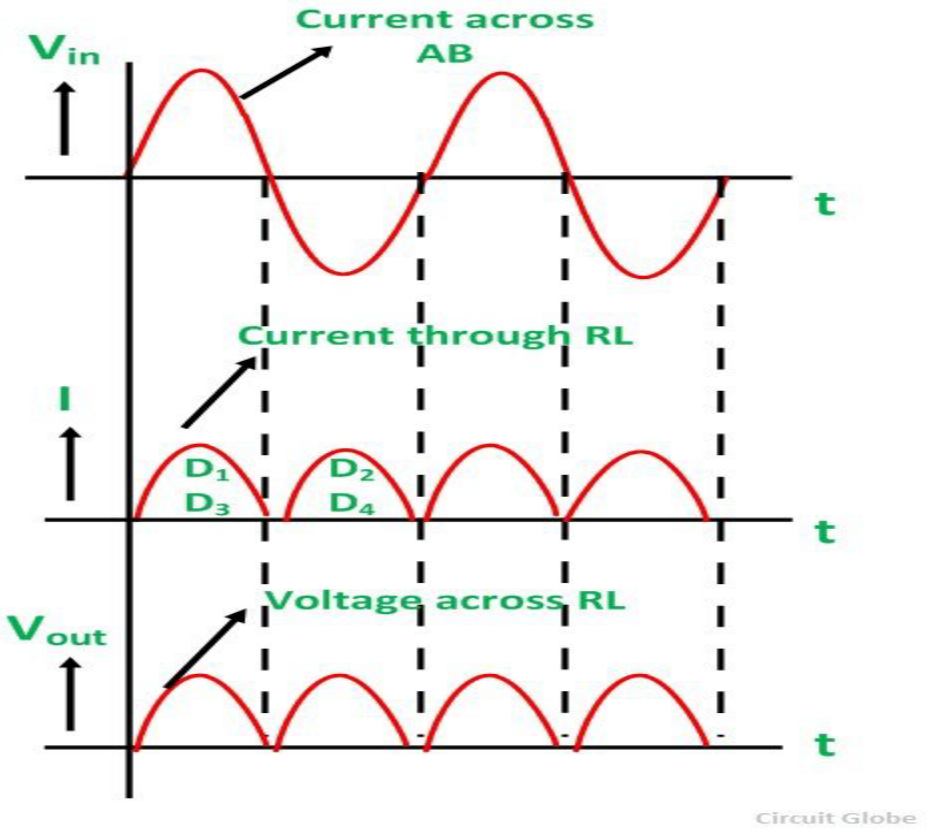
In **Full Wave Bridge Rectifier**, an ordinary transformer is used in place of a center tapped transformer. The circuit forms a bridge connecting the four diodes D_1, D_2, D_3, and D_4. The circuit diagram of Full Wave Bridge Rectifier is shown below.



The AC supply which is to be rectified is applied diagonally to the opposite ends of the bridge. Whereas, the load resistor R_L is connected across the remaining two diagonals of the opposite ends of the bridge.

Operation of Full Wave Bridge Rectifier

When an AC supply is switched ON, the alternating voltage V_{in} appears across the terminals AB of the secondary winding of the transformer which needs rectification. During the positive half cycle of the secondary voltage, the end A becomes positive, and end B becomes negative as shown in the figure below.



The diodes D_1 and D_3 are forward biased and the diodes D_2 and D_4 is reversed biased. Therefore, diode D_1 and D_3 conduct and diode D_2 and D_4 does not conduct. The current (i) flows through diode D_1, load resistor R_L (from M to L), diode D_3 and the transformer secondary. The waveform of the full wave bridge rectifier is shown below.

Capacitor Filter

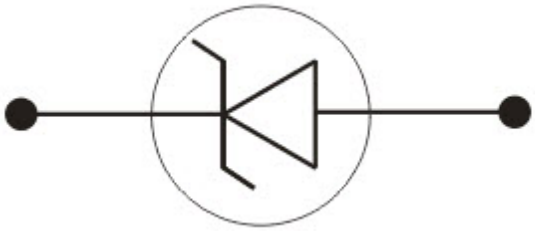
A filter capacitor is a capacitor which filters out a certain frequency or range of frequencies from a circuit.Usually capacitors filter out very low frequency signals. These are signals that are very close to 0Hz in frequency value. These are also referred to as DC signals.

How Filter Capacitors Work

How filter capacitors work is based on the principle of capacitive reactance. Capacitive reactance is how the impedance (or resistance) of a capacitor changes in regard to the frequency of the signal passing through it. Resistors are nonreactive devices. This means that resistors offer the same resistance to a signal, regardless of the signal's frequency. This means, for example, that a signal of 1Hz and a signal of 100KHZ, will pass through a resistor with the same resistance. Frequency isn't a factor. However, a capacitor is not like this. A capacitor is a reactive device. Its resistance, or impedance, will vary according to the frequency of the signal passing through. Capacitors are reactive devices which offer higher resistance to lower frequency signals and, conversely, lower resistance to higher frequency signals, according to the formula **XC= 1/2πfc**.
Being that a capacitor offers different impedance values to different frequency signals, it can act effectively as a resistor in a circuit. We will explain below how using actual circuits.

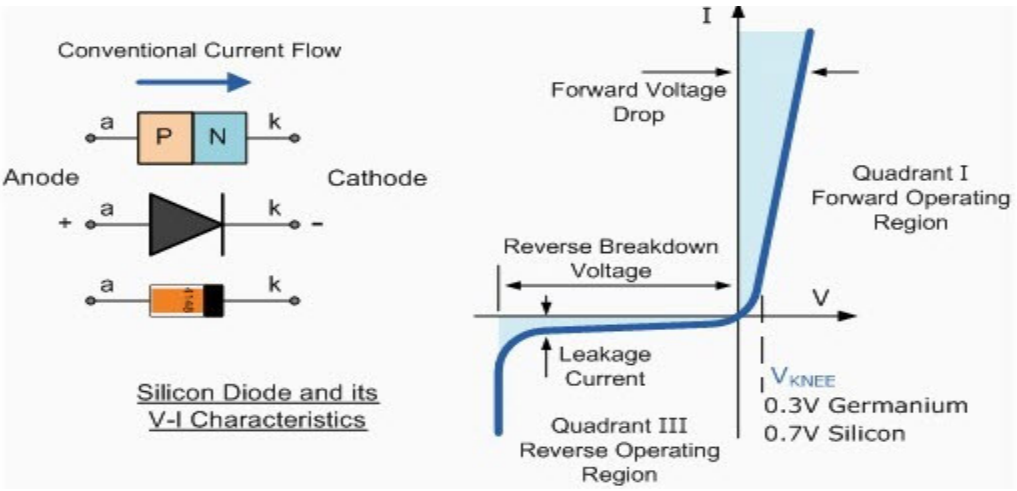
Zener Diode

The diode is one of the basic components in electronic circuits. When you want to know about voltage considerations you should know about the diodes. The diode is basically made up of semiconductors which have two characteristics, 'P' type and 'N' type. The 'P'type and 'N' type semiconductors represent positive and negative type semiconductors. 'P'type semiconductor will have excess amount of holes in configuration and 'N' type semiconductor will have excess amount of electrons. If both types of characteristics present in a single crystal then it can be termed as a diode. The positive terminal of the battery connects with the 'P' side and the negative side is connected with the 'N' side. Let's discuss about Zener diode working, It is nothing but a simple diode connecting in reverse bias.



Zener Diode Characteristics

It is mainly a special property of the diode rather than any special type of equipment. The person named Clearance Zener invented this property of the diode that's why it is named after him as a remembrance. The special property of the diode is that there will be a breakdown in the circuit if the voltage applied across a reversely biased circuit. This does not allow the current to flow across it. When the voltage across the diode is increased, temperature also increases and the crystal ions vibrate with greater amplitude and all these leads to the breakdown of the depletion layer. The layer at the junction of 'P' type and 'N' type. When the applied voltage exceeds an specific amount Zener breakdown takes place.



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2) www.learningaboutelectronics.com

3) www.elprocus.com

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