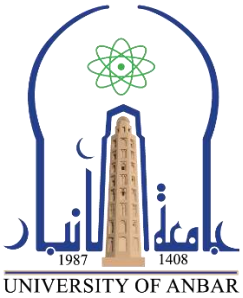

كلية : التربية للعلوم الصرفة

القسم او الفرع: الفيزياء

المرحلة: الثالثة

أستاذ المادة: م.م رؤى شاكر حماد

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اسم المحاضرة باللغة العربية: الانحياز الامامي

اسم المحاضرة باللغة الإنكليزية: Forward Bias

Forward Bias

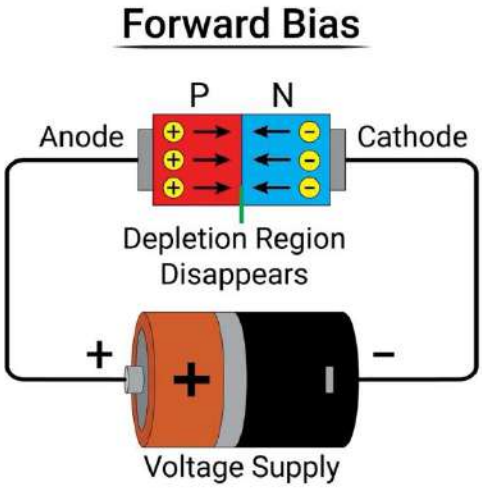
Forward Bias is a term commonly used in semiconductor electronics, particularly concerning diodes and transistors. A diode is considered to be in forward bias when its p-side is connected to the positive side of a power supply and its n-side to the negative side. In the case of an NPN transistor, the base-emitter junction is forward-biased, which means the base is positive relative to the emitter. Conversely, for a PNP transistor, the base is negative relative to the emitter.

Forward bias refers to a condition in electronics where a positive voltage is applied to the p-type material (anode) and a negative voltage to the n-type material (cathode) of a semiconductor device like a diode. This setup reduces the width of the depletion region at the p-n junction, which is a region devoid of free carriers (electrons and holes) and acts as a barrier to current flow in the diode

In forward bias, the applied voltage essentially narrows this depletion zone and lowers the barrier, allowing charge carriers to cross the junction. As a result, electrons can move from the n-type material to the p-type material, and holes can move in the opposite direction, allowing electric current to flow through the device.

Forward Bias Definition

When positive terminal of the battery is connected to p-region and the negative terminal of the battery is connected to n-region of the junction diode then its said to be forward biasing.



Effects of Forward Biasing

The following sequence of events happens in a forward biased junction diode.

- A number of electrons and holes combine with each other after they cross the junction potential.
- In other words, every hole of the p- junction will combine with an electron from the n – junction. This results in the breakage of covalent bonds and the electrons liberated due to the break of covalent bonds move to the positive terminal of the source.
- A number of electron hole pairs are formed.
- The current carriers in the p-region are holes and the current carriers in the n-region are electrons.

Forward Biasing Characteristics

The characteristics of a diode under forward bias:

- **Conductivity Increases**

In forward bias, the positive terminal of the voltage source is connected to the p-type (positive) semiconductor material, and the negative terminal is connected to the n-type (negative) semiconductor material. This arrangement reduces the potential barrier at the junction, allowing charge carriers (electrons in the n-type material and holes in the p-type material) to move across the junction more easily.

- **Reduction in Barrier Potential**

The forward bias reduces the potential barrier at the p-n junction. This barrier is essentially the energy barrier that prevents the flow of majority carriers across the junction. As the forward voltage is increased, the barrier potential decreases.

- **Current Flow**

With the reduced barrier potential, charge carriers can overcome the potential barrier and move across the junction. Current starts to flow through the diode in the direction of the external voltage.

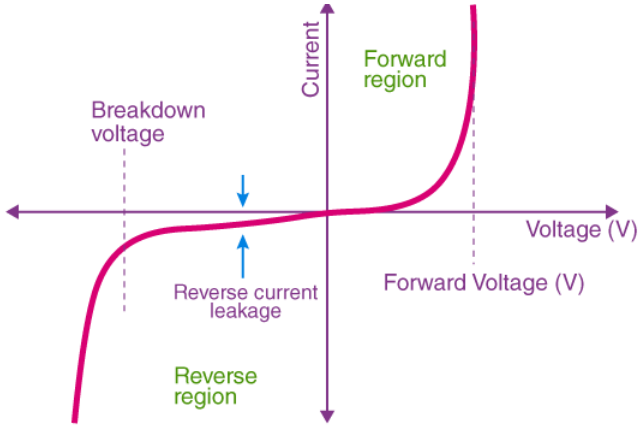
- **Low Resistance**

Under forward bias, the diode exhibits low resistance, allowing for efficient conduction of current.

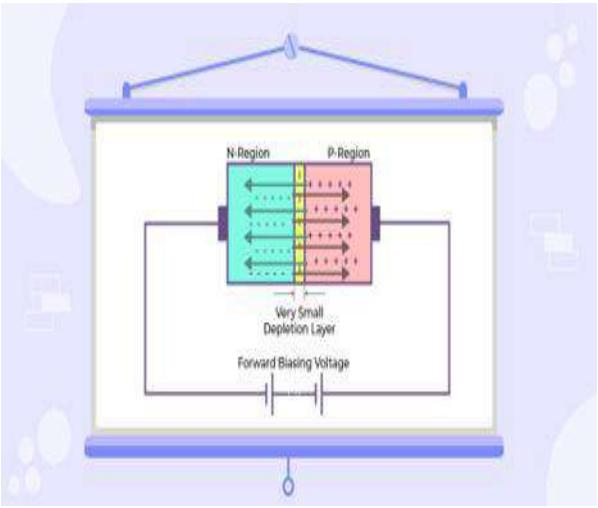
- **Forward Voltage Drop**

The forward voltage drop (Vf) is the voltage at which the diode starts conducting significantly. This voltage varies depending on the type of

diode (e.g., silicon diodes typically have a forward voltage drop of around 0.7 volts).



Forward Bias P-N Junction Diode



The p-n junction is said to be forward-biased when the p-type is connected to the positive terminal of the battery and the n-type to the negative terminal. The built-in electric field at the p-n junction and the applied electric field are in opposing directions when the p-n junction is forward biased.

When any type of P-N junction is in forward bias, a resistor Rs must be connected in series with the diode.The function of the limiting resistance is to limit the forward current into the diode.

Under forward bias the field of the space charge region and forward voltage Vd will oppose each other. Hence, the resultant electric field is very small, and it is experimentally found that the field is always directed from N to P. When the P-N junction is forward bias, the barrier height reduces by |V0|(magnitude of VD).