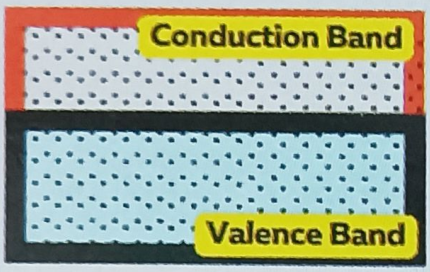
Semiconductors

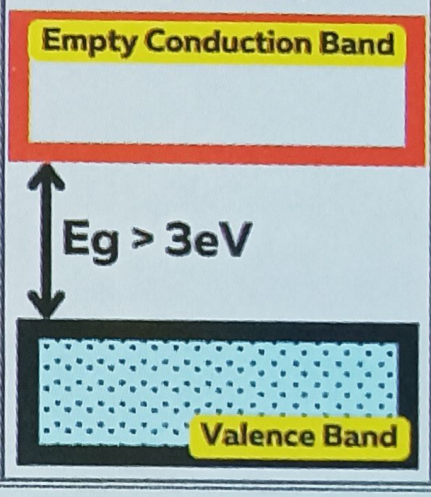
Conductors (Metals)

Overlapping Bands

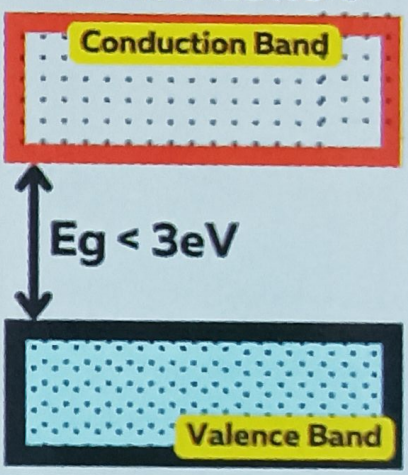
$E_g \approx 0$



Insulators



Semiconductors



Intrinsic Semiconductors

Semiconductor in its pure state is called intrinsic semiconductor

Extrinsic Semiconductor

A semiconductor doped with a suitable impurity to increase its conductivity is called extrinsic semiconductor

***n*-type Semiconductor**

Extrinsic semiconductor doped with pentavalent impurity like As, Sb, Bi, etc in which negatively charged electrons works as charge carrier, is called n-type semiconductor

$n_e \gg n_h$

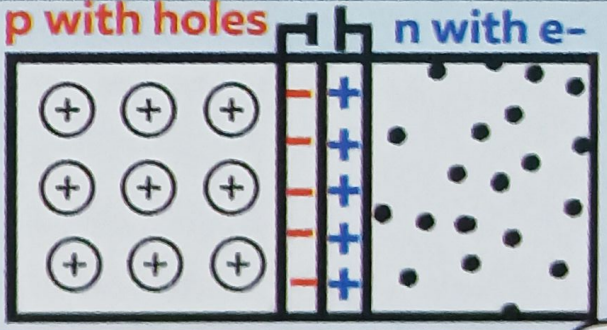
***p*-type Semiconductor**

Extrinsic semiconductor doped with trivalent impurity like Al, B, etc, in which positively charged holes works as charge carriers, is called p-type semiconductor

$n_h \gg n_e$

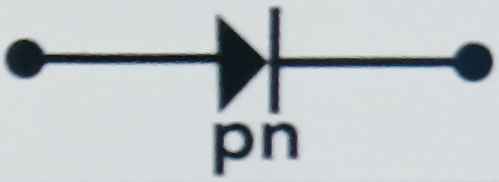
p-n Junction

An arrangement consisting a p -type semiconductor brought into a close contact with n-type semiconductor, is called a p-n junction.



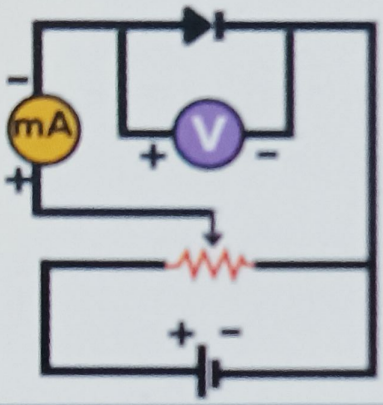
p-n Junction Diode

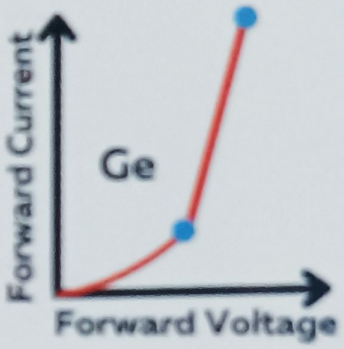
if the above junction is provided with metallic contacts at the ends for the application of external voltage, then it is called p-n junction diode



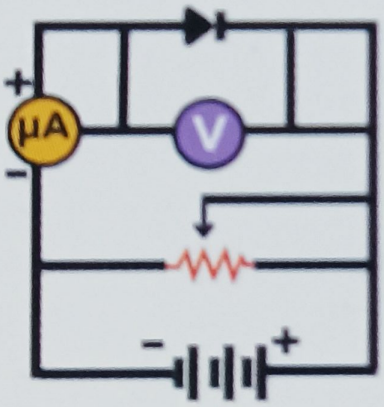
Voltage-Current Characteristic Curve of a p-n Junction Diode

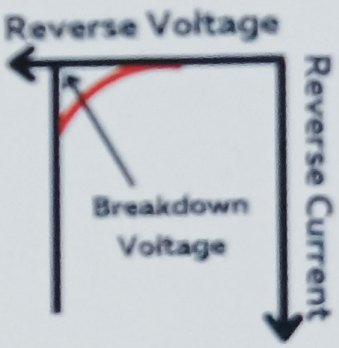
Forward Biased



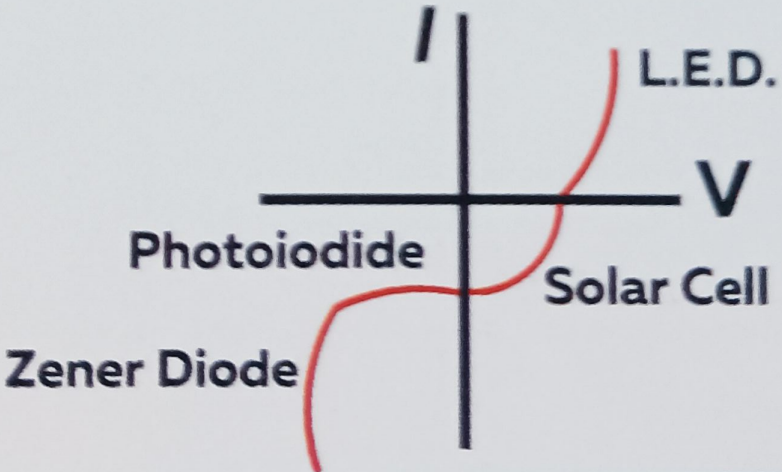


Reverse Biased





V-I Graph of Various Instruments

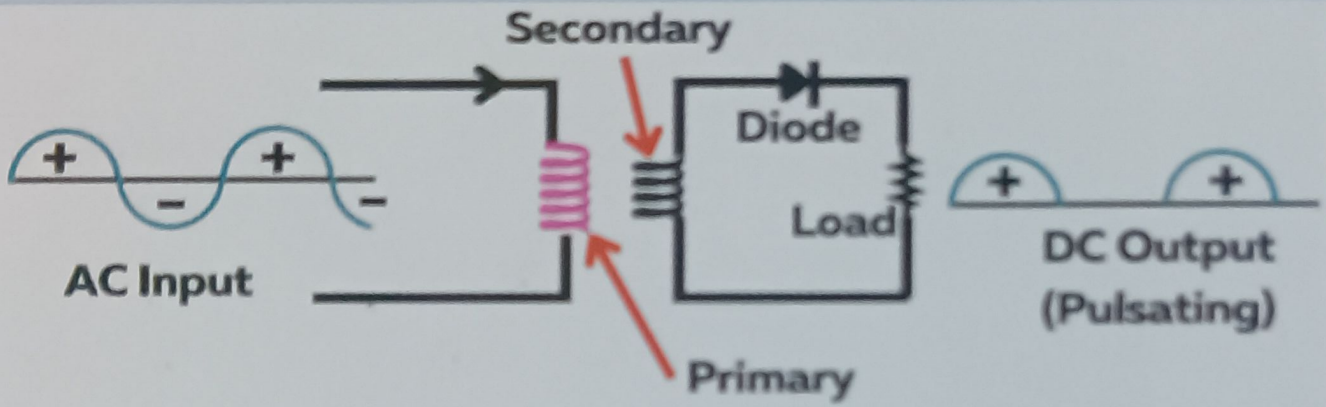


p-n Junction Diode as Rectifier

A device which converts alternating current or voltage into direct current or voltage is known as rectifier

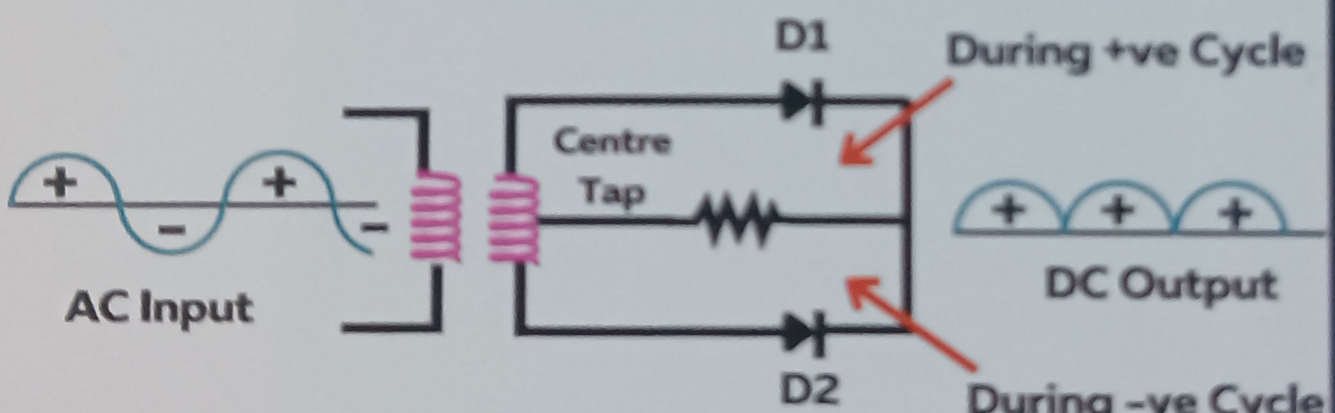
Half-Wave Rectifier

A half-wave rectifier converts the **half** cycle of applied AC signal into DC signal



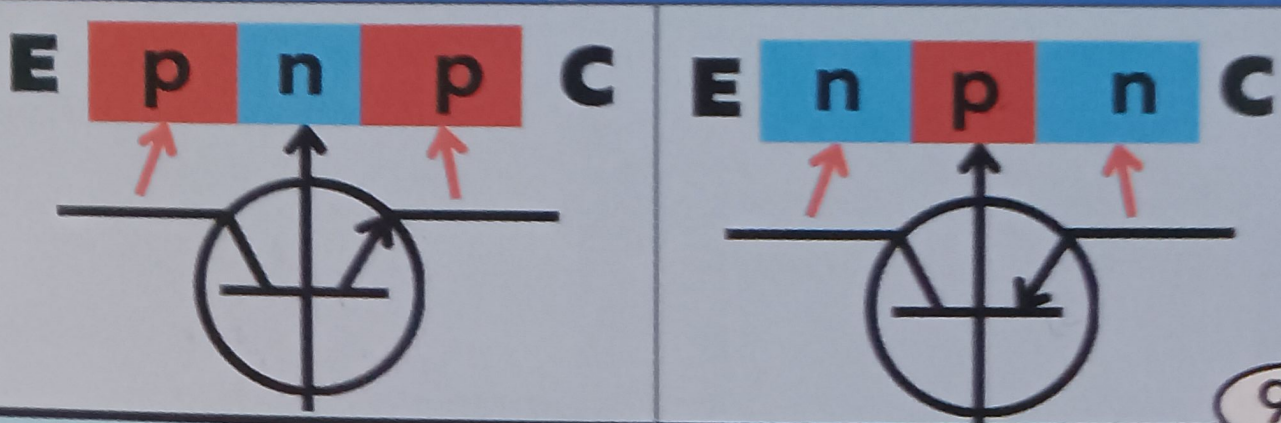
Full-Wave Rectifier

A full-wave rectifier converts the **whole** cycle of applied AC signal into DC signal

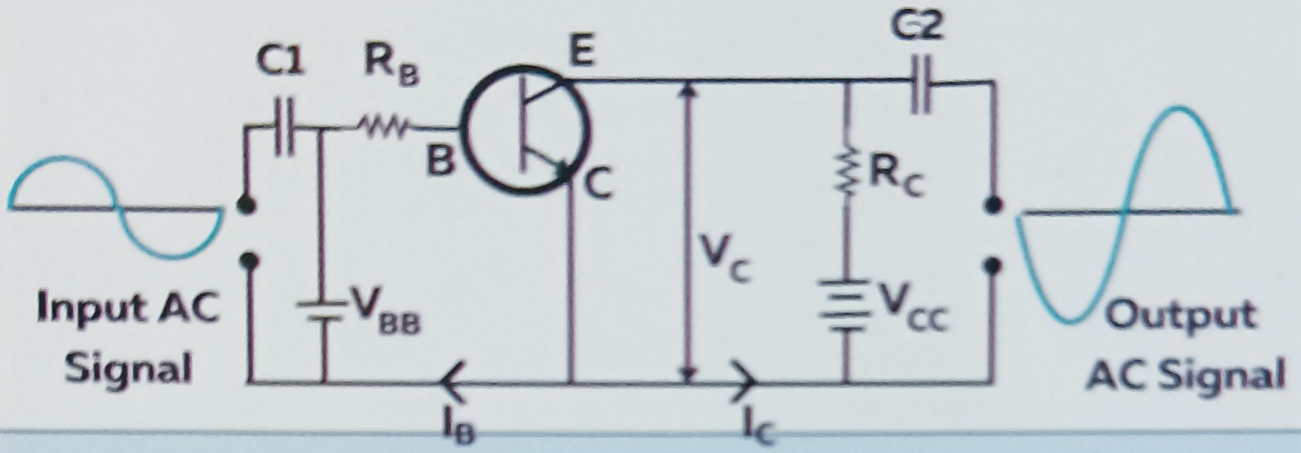


Transistor

A transistor is an arrangement obtained by growing a thin layer of one type of semiconductor between two thick layers of other similar type semiconductor



Transistor as an Amplifier



$$Current\ gain\ (\beta) = \frac{Output\ current}{input\ current} = \frac{I_c}{I_b}$$

$$Voltage\ gain\ (A_V) = \frac{Output\ voltage}{Input\ voltage} = \frac{V_{CC}}{V_{BB}}$$

$$Power\ gain\ (A_P) = \frac{Output\ power}{Input\ power} = \frac{I_c V_{CC}}{I_b V_{BB}}$$

$$A_P = A_C \beta$$

Transconductance

$$g_m = \frac{\beta}{R_{in}} = \frac{A_V}{R_L}$$

$$g_m = \frac{Output\ current}{Input\ voltage}$$

Boolean Algebra

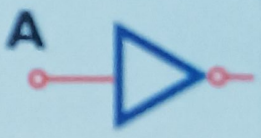
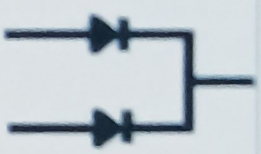
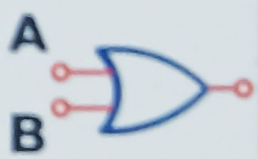
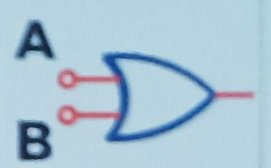
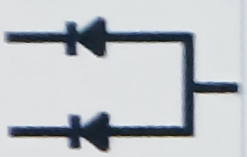
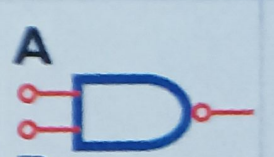
Addition	Multiplication	Inverse
$0+1=1$	$0.1=0$	$\bar{1}=0$
$1+1=1$	$1.1=0$	$\bar{0}=1$
$A+1=1$	$A.0=0$	$\bar{\bar{A}}=0$
$A+\bar{A}=1$	$A.1=A$	$\bar{\bar{1}}=0$
$A+0=A$	$A.\bar{A}=0$	$\bar{\bar{0}}=0$

De Morgan Law

$\overline{A+B} = \bar{A}.\bar{B}$	$\overline{A.B} = \bar{A}+\bar{B}$	$\bar{A}+\bar{B} = \overline{A.B}$

DIFFERENT COMBINATIONS

Input		OR	NOR	AND	NAND	X-OR	X-NOR
A	B						
0	0	0	1	0	1	0	1
0	1	1	0	0	1	1	0
1	0	1	0	0	1	1	0
1	1	1	0	1	0	0	1

Gate	Boolean Expression	Formed Using	Circuit Symbol	Electrical Circuit
NOT	$Y = \bar{A}$	Common Emitter(CE) Transistor		Key parallel with bulb
OR	$Y = A + B$			Two keys in parallel and in series with bulb
NOR	$Y = \overline{A+B}$ $= \bar{A}.\bar{B}$	Diode + CE Transistor		Two keys in parallel and in parallel with bulb
AND	$Y = A.B$			Two keys in series and in series with bulb
NAND	$Y = \overline{A.B}$ $= \bar{A}+\bar{B}$	CE + Two diode		Two keys in series and in parallel with bulb

- The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to the (1/16)th of its initial value? : **80 min**

- In hydrogen spectrum, the shortest wavelength in the Balmer series is λ. The shortest wavelength in the Bracket series is : **4λ**

- The radius of inner most orbit of hydrogen atom is 5.3×10^{-11} m. What is the radius of third allowed orbit of hydrogen atom? : **4.77 Å**

- The work functions of Caesium (Cs), potassium (K) and Sodium (Na) are 2.14 eV,2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photo e-? **Cs Only**

- The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of V volts is proportional to : **1/V**

- A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output? **Capacitor**