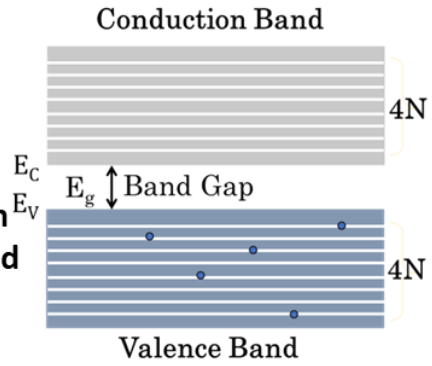
MIND MAP

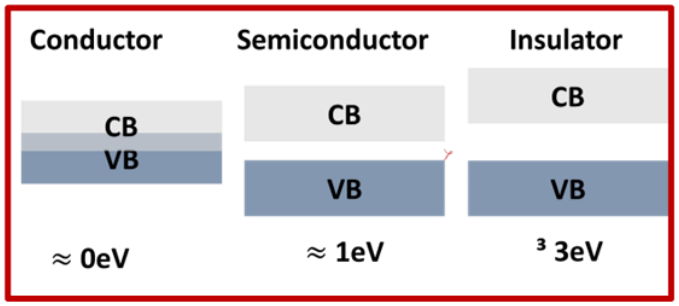
Semiconductor Electronics

Energy levels with continuous energy variation form Energy Band.

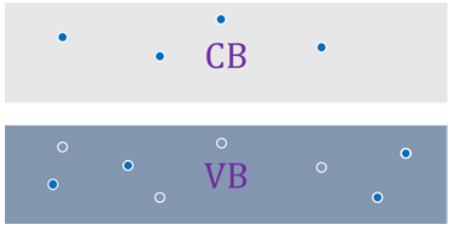


Energy gap between conduction band and valence band,

$E_g = E_C - E_V$



Intrinsic Semiconductor



In intrinsic semiconductor, the number of free electrons, n_e, is equal to the number of holes, n_h

$n_e = n_h = n_i$ (Intrinsic carrier concentration)

At thermal equilibrium **Generation rate = Recombination rate**

$$n_e \times n_h = n_i^2$$

- The deliberate addition of desirable impurity is called Doping.
- Added impurity atoms are called Dopants.

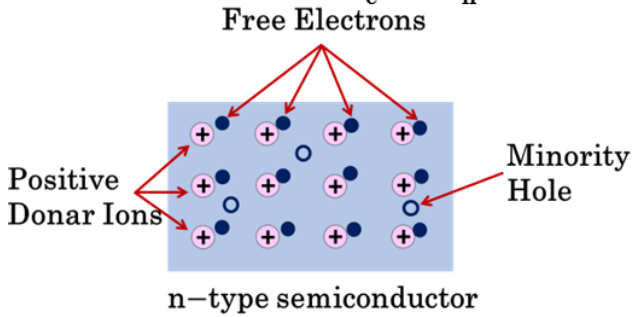
There are two types of dopants used in doping

(a) Pentavalent : Arsenic (As), Antimony (Sb), Phosphorous (P)

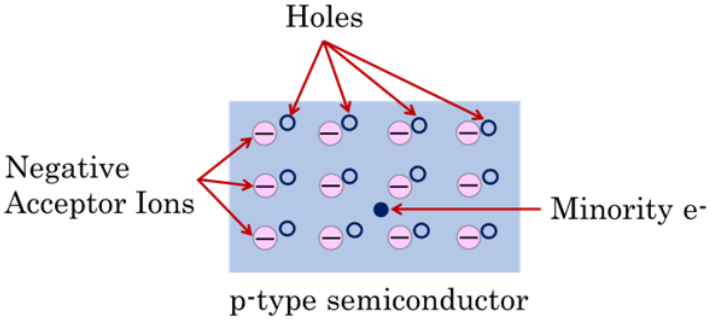
(b) Trivalent : Indium (In), Boron (B), Aluminium (Al)

Extrinsic Semiconductor

1. n-type semiconductor $n_e >> n_h$



2. p-type semiconductor $n_h >> n_e$

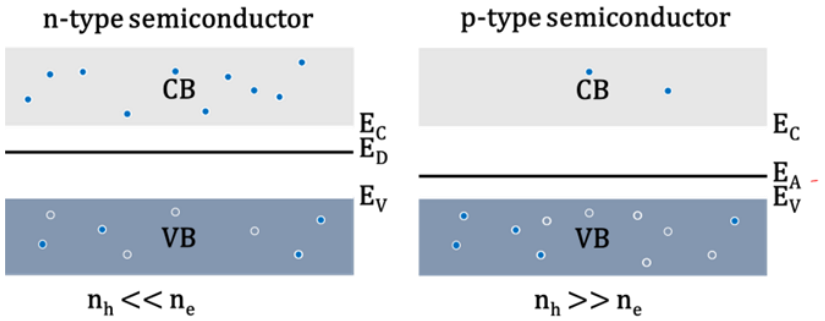


MIND MAP

Semiconductor Electronics

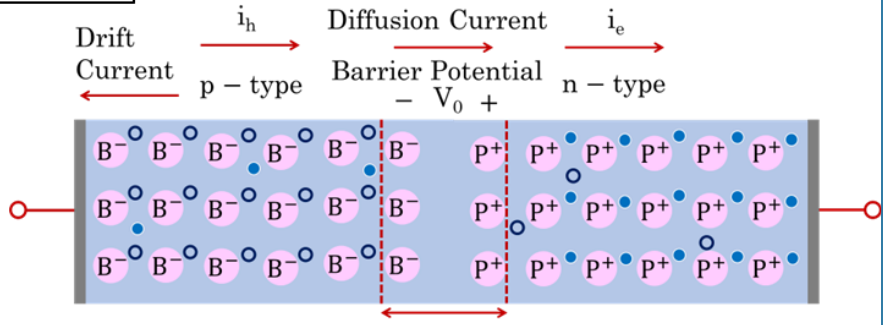
In extrinsic semiconductor the electron and hole concentration in a semiconductor in the thermal equilibrium is given by

Mass action law $n_e \times n_h = n_i^2$



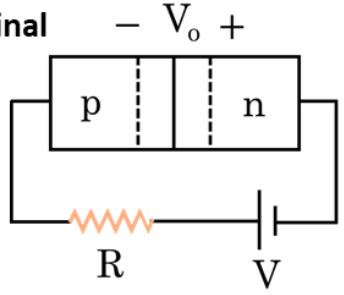
p–n Junction Diode

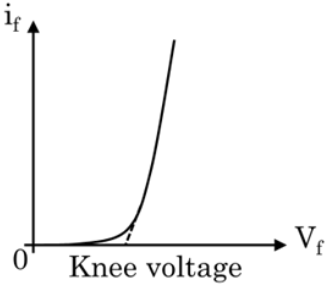
Si : V_0 = 0.7 eV	Ge : V_0 = 0.3 eV



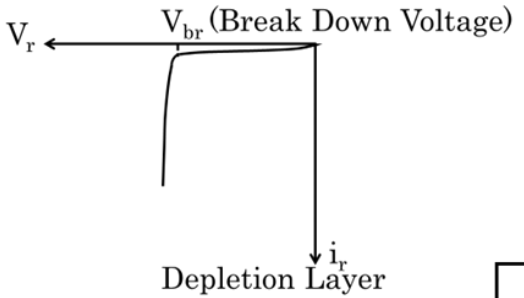
p–n Junction Under forward bias

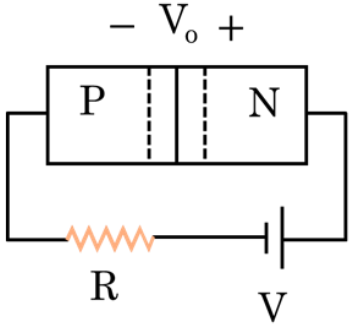
- When p side is connected to positive terminal and n side to the negative terminal, it is called forward bias.
- Due to applied voltage, electrons from n side cross the depletion region, and holes from p side cross the junction and reach n side. This process under forward bias is known as minority carrier injection.
- The total diode forward current is due to Diffusion.





p–n Junction Diode Under Reverse Bias

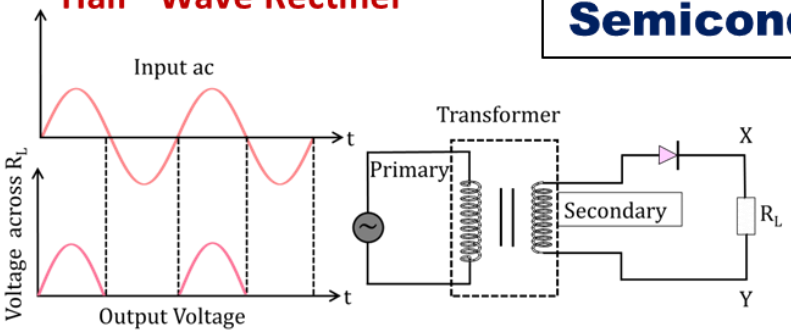




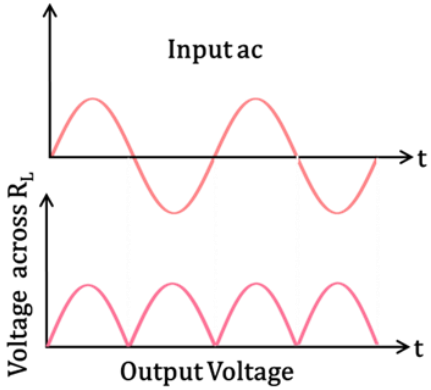
MIND MAP

Semiconductor Electronics

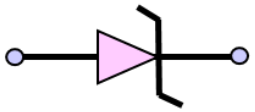
Half–Wave Rectifier



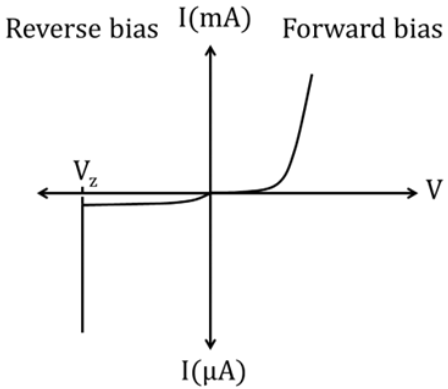
Full–Wave Rectifier



Zener Diode

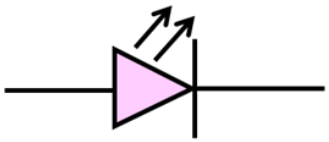


Zener diode acts as a Voltage Regulator.



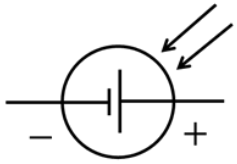
Light Emitting Diode

It is a heavily doped p-n junction which under forward bias emits spontaneous radiation.



On recombination, the energy is released in the from of photons.

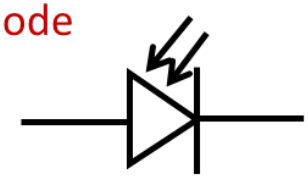
Solar cell

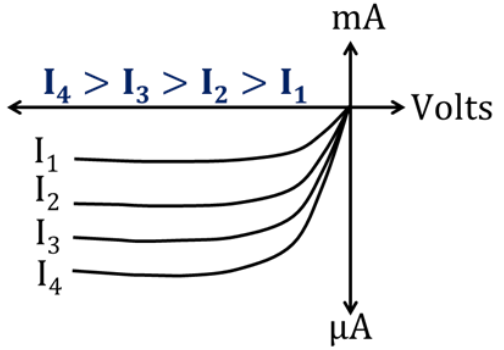


Electron – hole pair generated due to light with $h\nu > E_g$.

Photodiode

Photodiode operated under reverse bias.



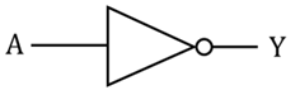


MIND MAP

Semiconductor Electronics

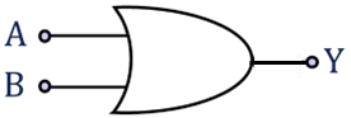
Logic Gates

NOT Gate



Input	Output
A	Y
0	1
1	0

OR Gate



Input		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

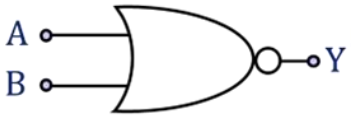
AND Gate

Input		Output
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

NAND Gate

Input		Output		
A	B	AND	NOT	NAND
0	0	0	1	1
0	1	0	1	1
1	0	0	1	1
1	1	1	0	0

NOR Gate



Input		Output		
A	B	OR	NOT	NOR
0	0	0	1	1
0	1	1	0	0
1	0	1	0	0
1	1	1	0	0