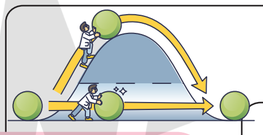
Semiconductor Electronics: Material Devices and Simple circuit

Classification of metals.Insulator And Semiconductor



ON THE BASIS OF CONDUCTIVITY

(1) For metals:

$S \sim 10^{-2} - 10^{-8}\ \Omega$ m

$\sigma \sim 10^{2} - 10^{8}$ S/m

They have high conductivity.

(2) For Semiconductors:

$S \sim 10^{-5} - 10^{6}\ \Omega$ m

$\sigma \sim 10^{5} - 10^{-6}$ S/m

They have intermediate conductivity to metals and insulators.

(3) For insulators:

$S \sim 10^{11} - 10^{19}\ \Omega$ m

$\sigma \sim 10^{-11} - 10^{-19}$ S/m

They have low conductivity

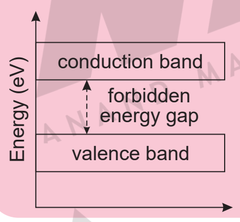
σ = electrical conductivity

ρ = resistivity

The band which is Completely filled with electrons at OK is called valence band.

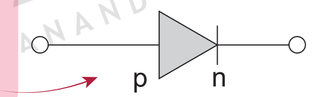
Conduction Band is completely empty at OK.

energy band gap is the difference between Valence band and Conduction band



SEMICONDUCTOR AND ITS TYPES

Semiconductors exhibit electrical conductivity between conductors and non – Conductors.



INTRINSIC SEMICONDUCTORS

(1) Pure Semiconductors are intrinsic Semiconductors.
(2) $N_i = N_e = N_r$, where, N_e = No. of free electrons, N_h = No. of holes, N_i = intrinsic carrier Concentration
(3) Examples:- Ge, Si

EXTRINSIC SEMICONDUCTORS

(1) Impure or doped Semiconductors are said to be extrinsic Semiconductors
(2) Impurities are added to improve Conductivity

N – type Semiconductor $N_e >> N_h$

(1) Electrons are majority charge carriers.
(2) Holes are minority charge carriers.
(3) Si or Ge doped with Pentavalent elements (P,As, Sb)

P – type Semiconductor $N_h >> N_e$

(1) Si or Ge doped with trivalent (B, Al) elements
(2) Electrons are minority charge carriers.
(3) Holes are majority charge carriers

THERMAL EQUILIBRIUM

The electron and hole Concentration in a Semiconductor in thermal equilibrium is given by. $N_e N_G = n_i^2$

P – N JUNCTION diode

P – N JUNCTION diode is the Combination of P – type and N – type Semiconductor.
P – region has mobile majority holes and immobile – ve ions.
N – region has mobile majority free electrons and immobile Positively charged ions.

POTENTIAL BARRIES

Potential barrier is the Potential difference developed across depletion region.
VB = 0.7 for Silicon
= 0.3 for germanium

FORWARD BIAS

In Forward Bias
(1) +ve terminal to P – Side
(2) -ve terminal to N – Side
(3) depletion layer reduced
(4) diffusion current increases

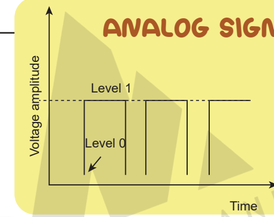
REVERSE BIAS

In reverse Bias
(1) -ve terminal to P – Side
(2) +ve terminal to N -Side
(3) depletion layer increases
(4) diffusion current increases

TRANSISTOR

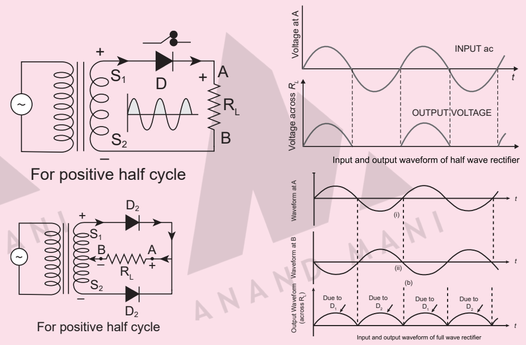
Transistor is a three terminal device
(1) Emitter (E)
(2) Base (B)
(3) Collector (C)

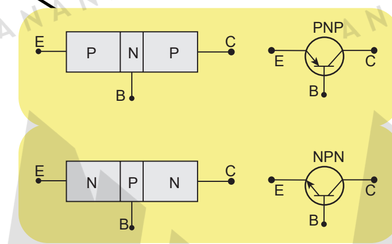
ANALOG SIGNAL



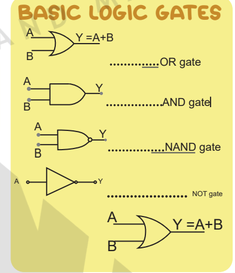
DIGITAL SIGNAL

APPLICATIONS OF JUNCTION DIVIDE

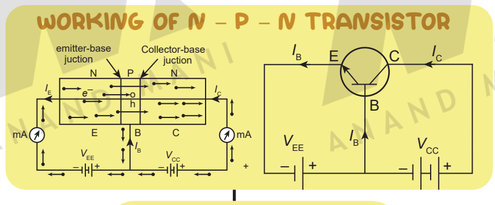




BASIC LOGIC GATES



WORKING OF N – P – N TRANSISTOR

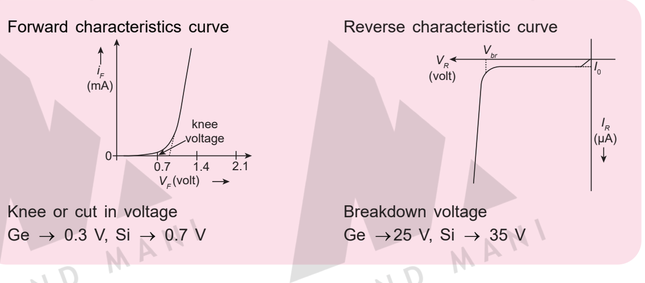


ZENER BREAKDOWN

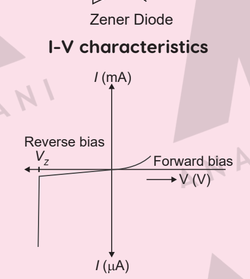
This phenomenon takes place in
(1) P – N junction having ' high doping'
(2) P – N junction having thin depletion layer
- Here, P –N junction does Not damage permanently

AVALANCHE BREAKDOWN

This phenomenon takes place in.
(1) P – N junction having 'low doping'
(2) P – N junction having thick depletion layer.
- Here, P – N junction damages permanently due to abruptly increment of minorities during repetitive collisions.

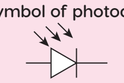


SEMICONDUCTOR ZENERDIONDE DIODES

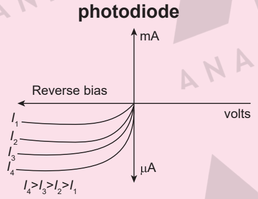


PHOTODIODE

The symbol of photodiode is

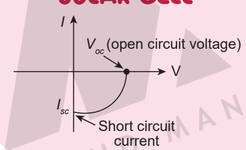


I-V characteristics of a photodiode

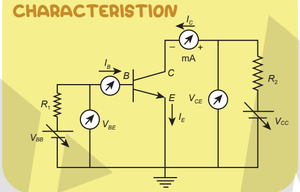


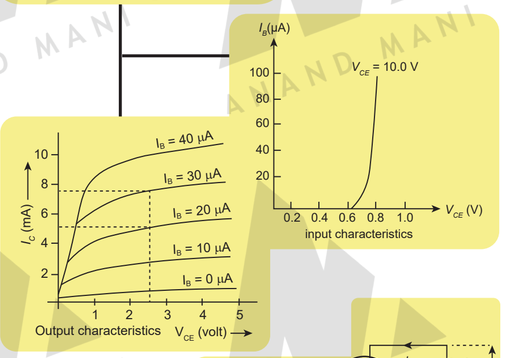
I-V CHARACTERISTICS OF A SOLAR CELL.

SOLAR CELL



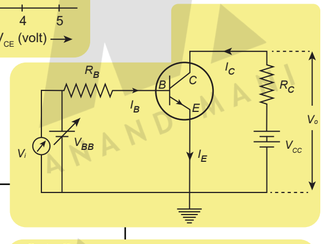
CE CONFIGURATION CHARACTERISTION



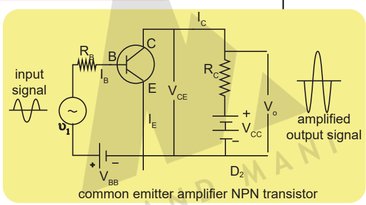


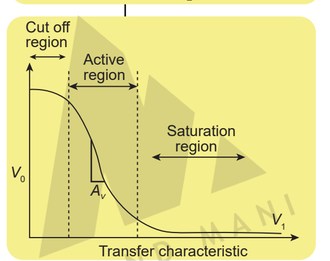
APPLICATION OF TRANSISTOR

AS A SWITCH

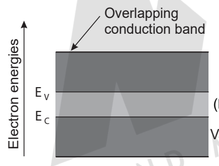


AS AN AMPLIFIER

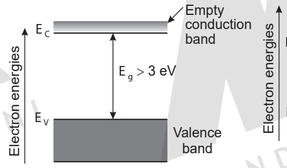




CONDUCTOR (METAL)



INSULATOR



SEMICONDUCTOR