MASTERJEE CLASSES

Class XII

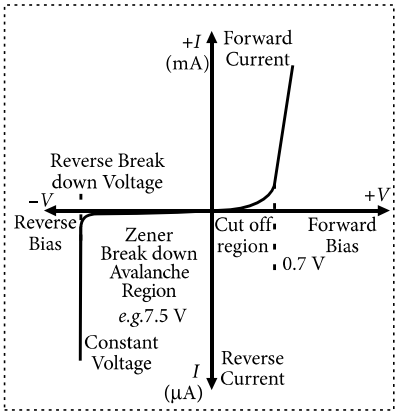
SEMICONDUCTOR ELECTRONICS

BRAIN MAP

TYPES OF SEMICONDUCTORS

INTRINSIC SEMICONDUCTORS

The pure semiconductors have thermally generated current carriers. Here, $n_e = n_h = n_i$



EXTRINSIC SEMICONDUCTORS

The semiconductor whose conductivity is mainly due to doping of impurity.

p-type semiconductor

- Doped with trivalent atom.
- Here, $n_h >> n_e$

n-type semiconductor

- Doped with pentavalent atom.
- Here, $n_e >> n_h$

SEMICONDUCTOR DIODE

***p–n* junction diode :** A *p*-type semiconductor is brought into contact with an *n*-type semiconductor such that structure remains continuous at boundary.

BIASING CHARACTERSTICS

Forward bias characteristic

- Width of depletion layer decreases
- Effective barrier potential decreases
- Low resistance at junction
- High current flow of the order of mA.

Reverse bias characteristic

- Width of depletion layer increases
- Effective barrier potential increases
- High resistance at the junction
- Low current flow of the order of μA.
- Reverse break down occurs at a high reverse bias voltage.

APPLICATIONS OF DIODE

- **Diode as a rectifier**
  - Half wave rectifier
  - Full wave rectifier
- **Zener diode** as a voltage regulator.
- **Photo diode** for detecting light signals.
- **LED:** light emitting diode.
- **Solar cells:** Generates emf from solar radiations.

JUNCTION TRANSISTOR

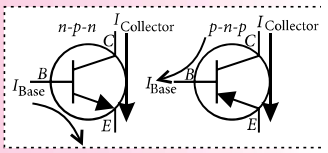
A semiconductor device possessing fundamental action of transfer resistor.

Junction transistors are of two types

- ***n-p-n* transistor:** A thin layer of *p*-type semiconductor is sandwiched between two *n*-type semiconductors.
- ***p-n-p* transistor:** A thin layer of *n*-type semiconductor is sandwiched between two *p*-type semiconductors.

There are three configurations of transistors

- CB (Common Base)
- CE (Common Emitter)
- CC (Common Collector).



Transistor characteristics

- Input resistance $(r_i)_{(CE)} = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)_{V_{CE}=\text{constant}}$
- Output resistance $(r_o)_{(CE)} = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right)_{I_B=\text{constant}}$
- Current amplification factor

$$\beta_{ac} = \left(\frac{\Delta I_C}{\Delta I_B}\right)_{V_{CE}=\text{constant}} \qquad \alpha_{ac} = \left(\frac{\Delta I_C}{\Delta I_E}\right)_{V_{CB}=\text{constant}}$$

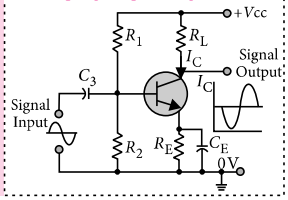
APPLICATIONS OF TRANSISTOR

- **Transistor as an Amplifier**
  - Its operating voltage is fix in active region.
  - Voltage gain,

$$A_v = \frac{V_o}{V_i} = -\beta_{ac}\frac{R_{out}}{R_{in}}$$

  - Power gain, $A_p = A_v \times \beta_{ac}$
- **Transistor as a Switch**
- **Transistor as an Oscillator**

CE(n-p-n) Amplifier



DIGITAL ELECTRONICS AND LOGIC GATES

VARIOUS TYPES OF LOGIC GATE

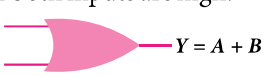
AND Gate

Output is high only when both inputs are high.

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

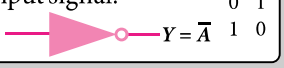
Output is high if any one or both inputs are high.



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate

It just inverts the input signal.



A	Y
0	1
1	0

NAND Gate

An AND Gate followed by a NOT Gate.

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate

An OR Gate followed by a NOT Gate.

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0