Chapter 14

SEMICONDUCTOR ELECTRONICS

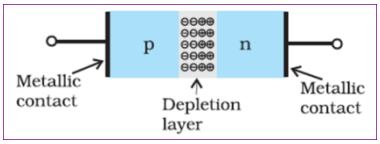
(Prepared By: Ayyappan C, HSST Physics, GMRHSS, Kasaragod)

p-n JUNCTION

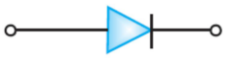
- A junction formed when a p-type semiconductor and n-type conductor are brought together is called a p-n junction.

SEMICONDUCTOR DIODE (p-n junction Diode)

- A semiconductor diode is a p-n junction with metallic contacts provided at the ends for the application of an external voltage.
- It is a two terminal device.



Symbol



- The barrier voltage of a **Ge** diode is **0.2V** and that of a **Si** diode is **0.7V**.

p-n junction diode under forward bias

- In forward biasing the **p-side is connected** to the **positive terminal** of the battery and **n-side to the negative terminal**.
- In forward bias, the junction offers a very low resistance to the flow of current

p-n junction diode under reverse bias

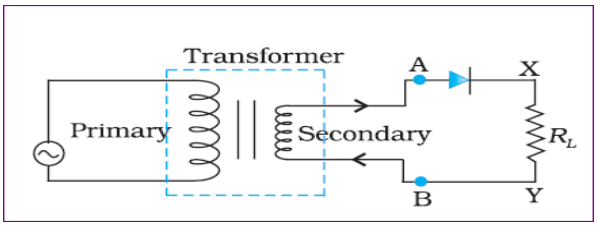
- In reverse biasing **n-side is connected to positive** of the battery and **p-side to negative** of the battery.
- In reverse biasing Junction resistance is very high for current flow

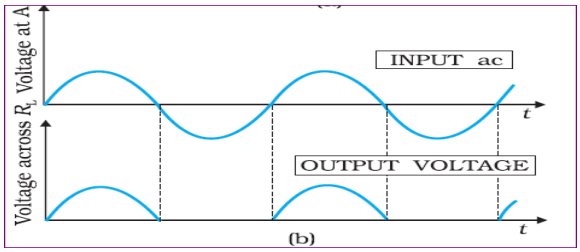
APPLICATION OF JUNCTION DIODE - RECTIFIER

- The process of conversion of ac current to dc current is called **rectification.**
- Device used for rectification is called rectifier.

Half wave Rectifier:

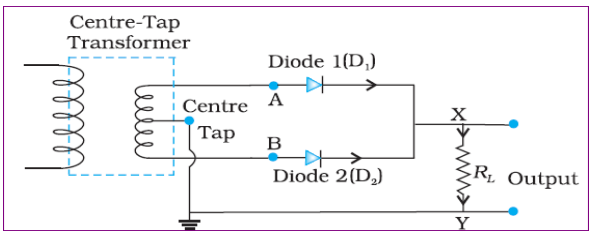
- It uses only one diode.
- The diode becomes forward biased only in the positive half cycle of ac.
- Efficiency is only 40.6%.

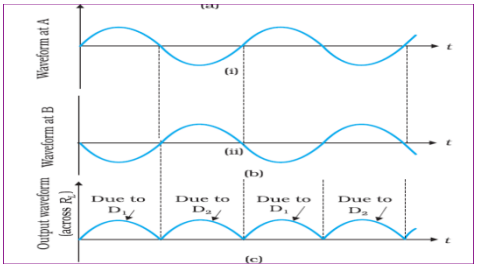




Full wave rectifier

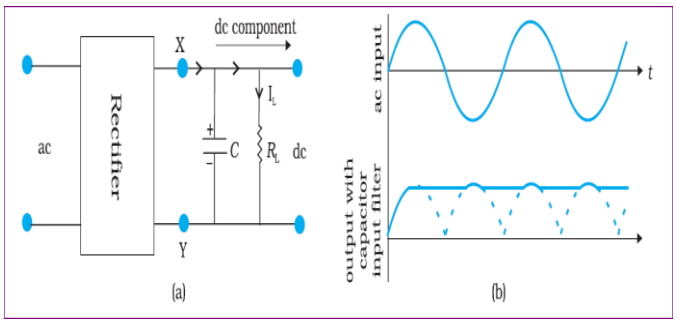
- A simple full wave rectifier consists of two diodes.
- A centre tapped transformer is used in the circuit.
- During the positive half cycle first diode conducts current and second diode during negative half cycle.





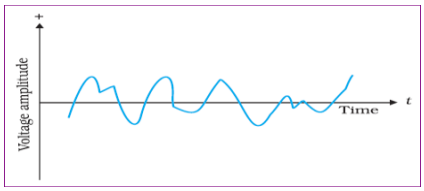
Filters

- The circuits used to filter out the ac ripples from the rectifier output are called **filters.**
- The capacitor input filters use large capacitors.

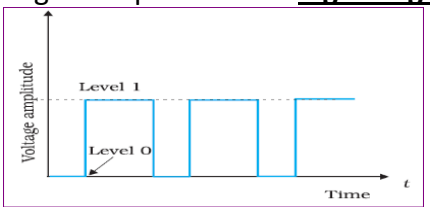


DIGITAL ELECTRONICS

- In digital circuits only two values (represented by 0 or 1) of the input and output voltage are permissible.
- The continuous, time-varying voltage or current signals are called **continuous or *analogue signals.***



- *A waveform in which only* discrete values of voltages are possible is a **digital signal.**



Logic gates

- A logic gate is a digital circuit that follows curtain *logical relationship* between the input and output voltages.
- The five common logic gates used are **NOT, AND, OR, NAND, NOR.**
- NOT, OR, and AND gates are **fundamental or basic gates.**
- NAND and NOR gates are called **universal gates.**

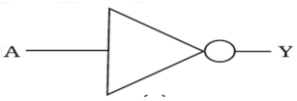
NOT gate

- This is the most basic gate, with one input and one output.
- It produces an inverted version of the input at its output.
- It is also known as an ***inverter.***
- The table which describes the input output relationship is known as **truth table.**

Truth table

Input	Output
A	Y
0	1
1	0

Symbol



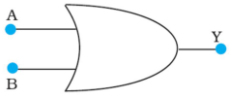
OR Gate

- It can have one output and any number of inputs.

Truth table

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

Symbol



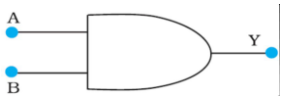
AND Gate

- It can have one output and any number of inputs.

Truth table

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

Symbol



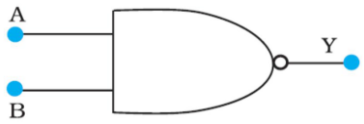
NAND Gate

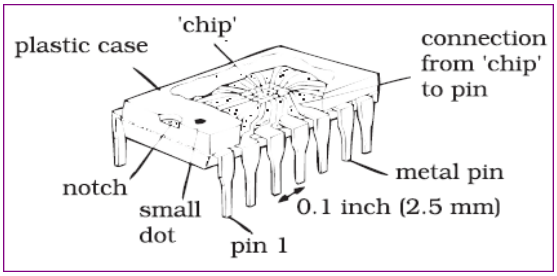
- It is a combination of AND and NOT Gate

Truth table

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

Symbol





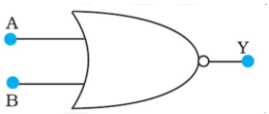
NOR Gate

- It is a combination of OR gate and NOT gate.

Truth table

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

Symbol



INTEGRATED CIRCUITS (IC)

- An entire circuit fabricated (consisting of many passive components like R and C and active devices like diode and transistor) on a small single block (or chip) of a semiconductor is called **integrated circuit.**
- Depending on nature of input signals, IC's can be grouped in two categories: **linear or analogue IC's** and **digital IC's**
- Depending upon the level of integration (i.e., the number of circuit components or logic gates), the IC's are termed as
- **Small Scale Integration, SSI (logic gates < 10)**
- **Medium Scale Integration, MSI (logic gates < 100)**
- **Large Scale Integration, LSI (logic gates < 1000)**
- **Very Large Scale Integration, VLSI (logic gates > 1000).**
- The most widely used IC technology is the *Monolithic Integrated Circuit.*

*****