Subject — AEC [Analog Electronic Circuit]

Module -1 (Diode Circuit)

Date.....

# Introduction of Analog Electronic Circuits :→

- Definition :— Analog Electronic circuits are circuits that deal with continuously varying signals. These circuits process signals that can have an infinite number of values, unlike digital circuits.

- Key features :→

- Work with real-word signals (sound temperatures light)
- Signals are represented in sine waves or continuous waveform.
- Components commonly used :— Resistor, Capacitors, inductors, diode, and ~~temp~~ transistor

# Applications :→

- Audio and video amplifiers
- Radio - frequency (RF) systems
- Sensors and Instrumentation system.
- Signal processing circuits.

Date.....

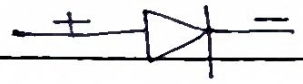
# Topic :- Diodes and their Applications

## 1. Diode Basics :-

→ A diode is a two-terminal electronics component that allows current to flow in one direction only

→ Constructed using PN Junction

→ Symbol :-



## 2. Types of Diodes :-

- PN Junction Diode (Basic)
- Zener Diode (used for voltage regulation)
- light Emitting Diode (LED)
- Photo Diode
- Schotty Diode

## 3. VI - Characteristics of a Diode

- Forward Bais : Current flow easily ; diode conduct
- Reverse Bais : very small leakage current until breakdown
- knee - voltage : the voltage at which diode start conducting significantly.

Date.....

## = P-N Junction Diode :→

P-N Junction Diode is a semiconductor device formed by joining p-type and n-type semiconductor together. It allow current to flow in only one direction - from p-side to the n-side and block it in the reverse direction.

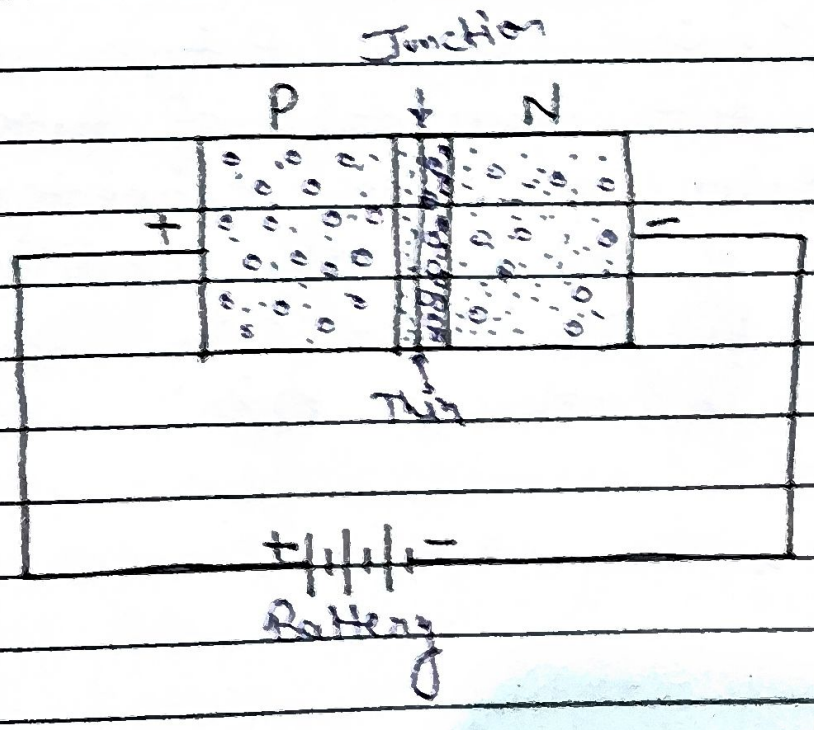
**P-type :→** Majority carriers holes
And Minority carriers Electrons

**N-type :→** Majority carriers Electron
Minority carriers holes

**In P-N Junction Baising two type :→**

Baising →
- → Forward Bais (Connection +ve to +ve and -ve to -ve)
- → Reverse Bais (Connection +ve to -ve and -ve to +ve

**Forward Bais :—**



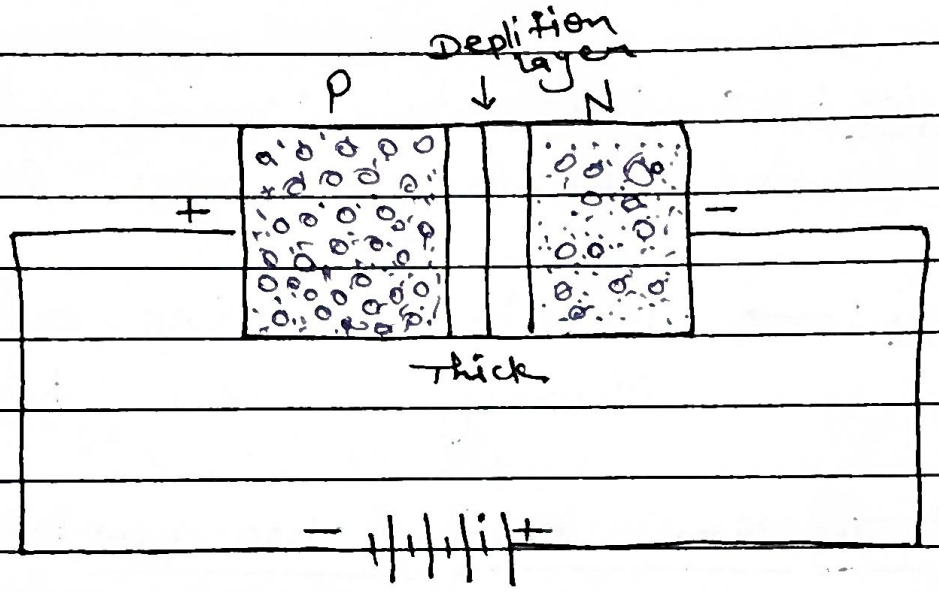



Teacher's Sign.....

Date.....

This Diagram shown a PN Junction Diode in forward Bais when P type semiconductor connected to the positive terminal of Battery then N type semiconductor of PN Junction diode is connected to the negative terminal of Battery this condition makes forward Bais. The Depletion layer is thin. in forward Bais.

Reverse Bais :—

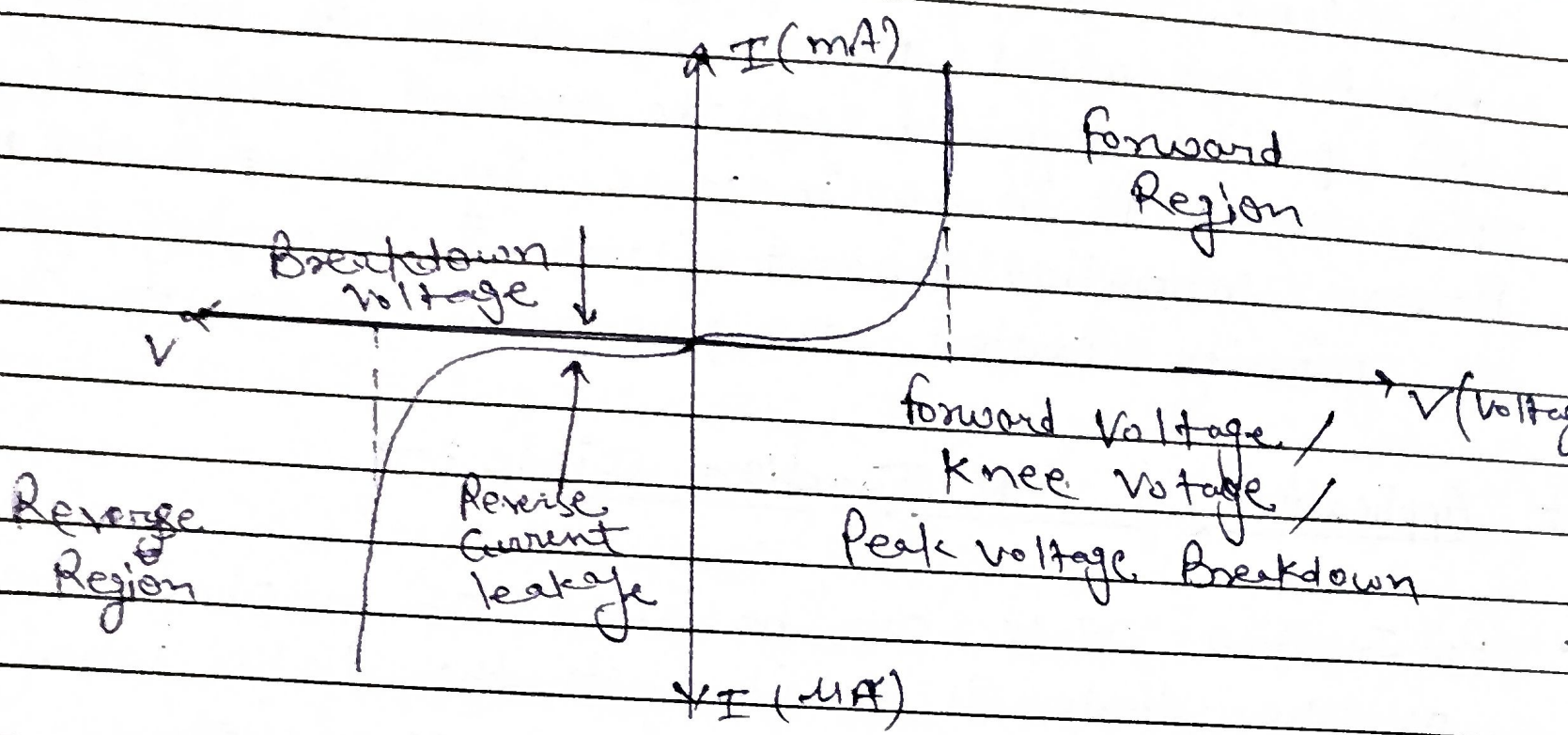



P type semiconductor have majority of holes
N typ semiconductor have majority of electron

This Diagram shown a P-N Junction Diode in Reverse Bais when P type semiconductor connected to the −re terminal of Battery then N type semiconductor of diode. connected to the positive terminal of Battery. This condition of maker Reverse Bais PN Junction. The Depletion layer is thick in Reverse Bais.

Date.....

# V-I characteristic of PN Junction Diode :→




## Three types of Baising :→

- Zero Bais
- Forward Bais
- Reverse Bais

→ When the PN Junction Diode is in Zero Bais Condition, there is no external voltage applied and this means that the potential Barrier at the junction does not flow of current

→ When the PN Junction diode is in forward Bais Condition the p-type is connected to the +ve terminal while the n-type is connected to the -ve terminal of the external voltage. When the diode is arranged in this manner, there is a reduction in the potential barrier. for silicone diodes, when the voltage is 0.7V and for Germanium diodes, when the voltage is 0.3V, the potential barriers rise and flow of current.



Teacher's Sign.....

Date.....

→ When the PN Junction diode is in Reverse Bais Condition, when the p type is connected to the negative terminal while the n-type is connected to the positive terminal of the external Battery/voltage. This result is in on increase in the potential Barrier Reverse saturation current flows in the begining as minority carriers are present in the junction.

# Application of P-N Junction Diode :→

- PN Junction Diode can be used as a photodiode as the diode is sensitive to the light when the configuration of the diode is reverse Baised.
- It can be used as a solar cell
- When the diode is forward Baised. It can be used in LED lightning applications.
- It is used as rectifier in many electric ckt and they are also used as a voltage - controlled oscillator in varactors.

Date.....

# Rectifier :→

A rectifier is a device which converts an alternating (AC) input voltage into direct (DC) output voltage. Any electrical device which has a high resistance to current in one direction and low resistance to current in opposite direction possesses the ability to convert AC current to DC current.

## Principle :→

A rectifier's core principle is to convert Alternating to DC current. This Conversion is achieved by leveraging the unidirectional Current flow characteristic of diode.

## Two types of Rectifier :→

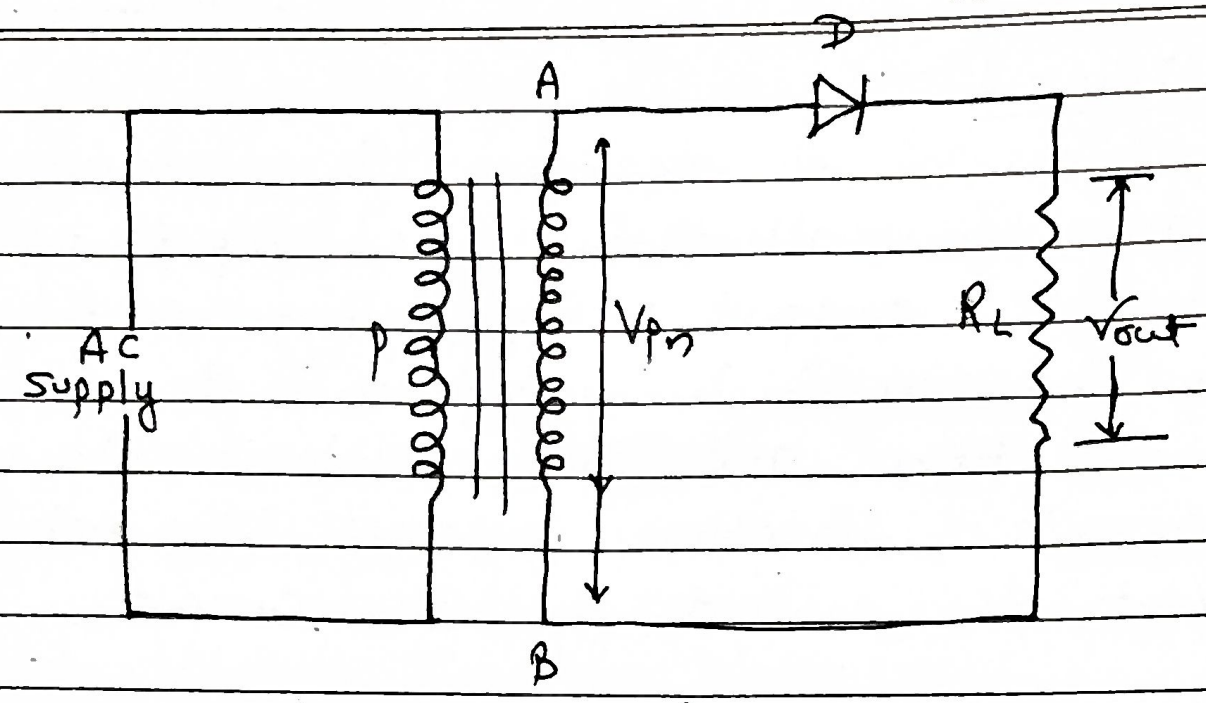
(a) Half-wave Rectifier
(b) full-wave Rectifier

## (a) Half-wave Rectifier :→

## Construction :→

The arrangement for a half-wave rectifier is shown in fig. The AC input voltage is fed across the primary coil P of a suitable step-down transformer. The secondary coil S of the transformer is connected to the semiconductor pn-junction diode D and a load resistance $R_L$.

Date.....

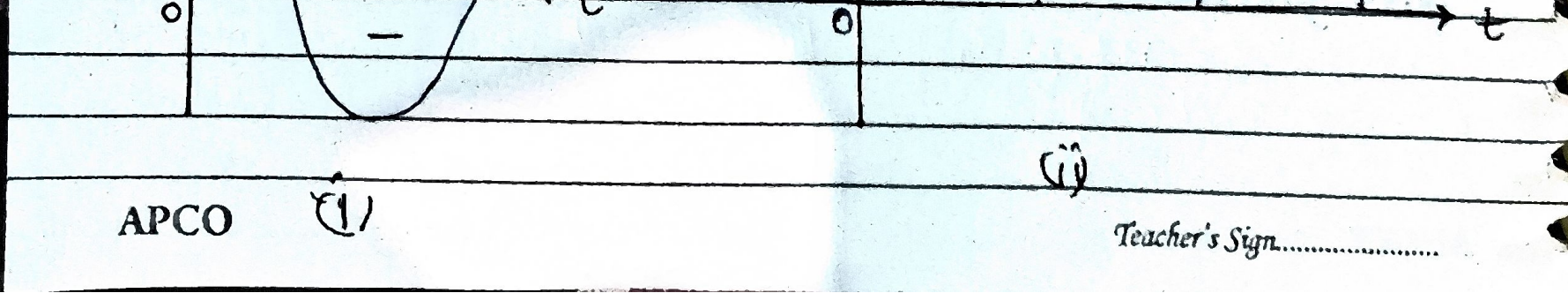



Half wave Rectifier

Working Method :→

Lets during the first half of AC input cycle, the end A of secondary S of transformer be at positive potential and end B at the negative positive potential. In this situation, the diode is forward baised and current flows in the circuit. Consequently, an output voltage across load $R_L$ obtained.

During the second half AC input, the end A of secondary S of transformer is at negative potential and diode D is in reverse bias So, no current through load $R_L$ and there is no output voltage across $R_L$




APCO

Teacher's Sign.....

Date.....

In the next positive half cycle of AC input. we again get the output and so on. There we get output voltage as shown in fig. Here, the output voltage, though still varying in magnitude is restricted to only one direction and is said to be rectified. Since, the rectified output of the circuit is obtained only for half of the AC wave, the device is called Half-wave Rectifier.

## (b) Full-wave Rectifier :→

A full wave rectifier which rectifies both halves of each AC input cycle and gives a unidirectional output voltage continuously.

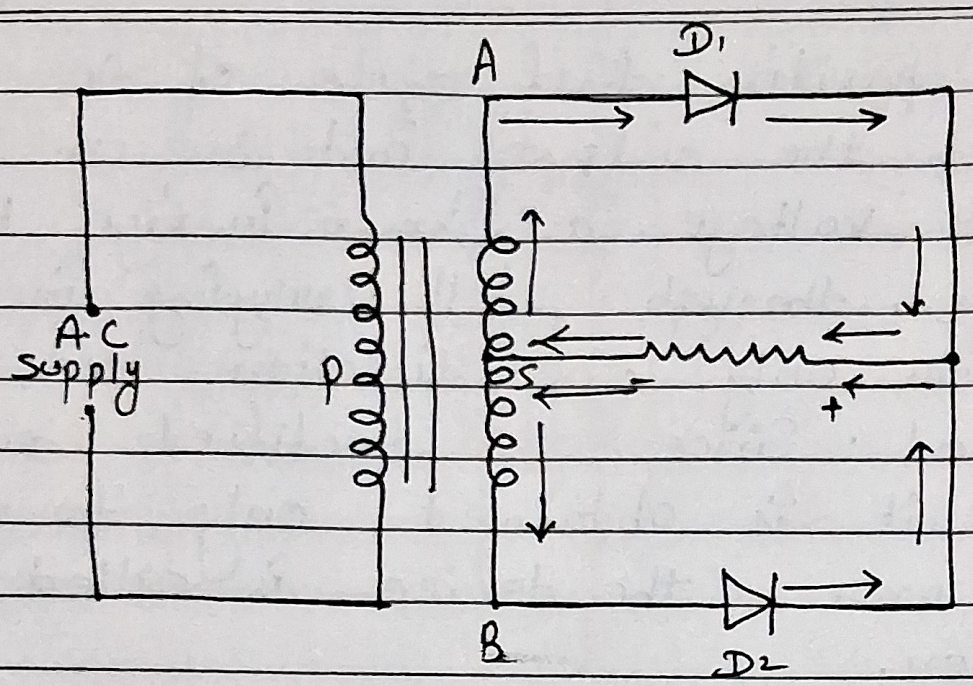
### Construction :→

In full wave rectifier, ~~is the rectifier~~ we use two semiconductor diode which operate in a complementary mode. The AC input supply is fed across the primary coil P of a center tap transformer. The two ends A and B of the second S of the Transformer are connected to the p-side ends of the diode $D_1$ and $D_2$ respectively. A load resistance ($R_L$) is connected between the n-terminal of both the diode and the center tapping O of the second of transformer. The DC output is obtained across load resistance $R_L$.



Teacher's Sign.....

Date.....



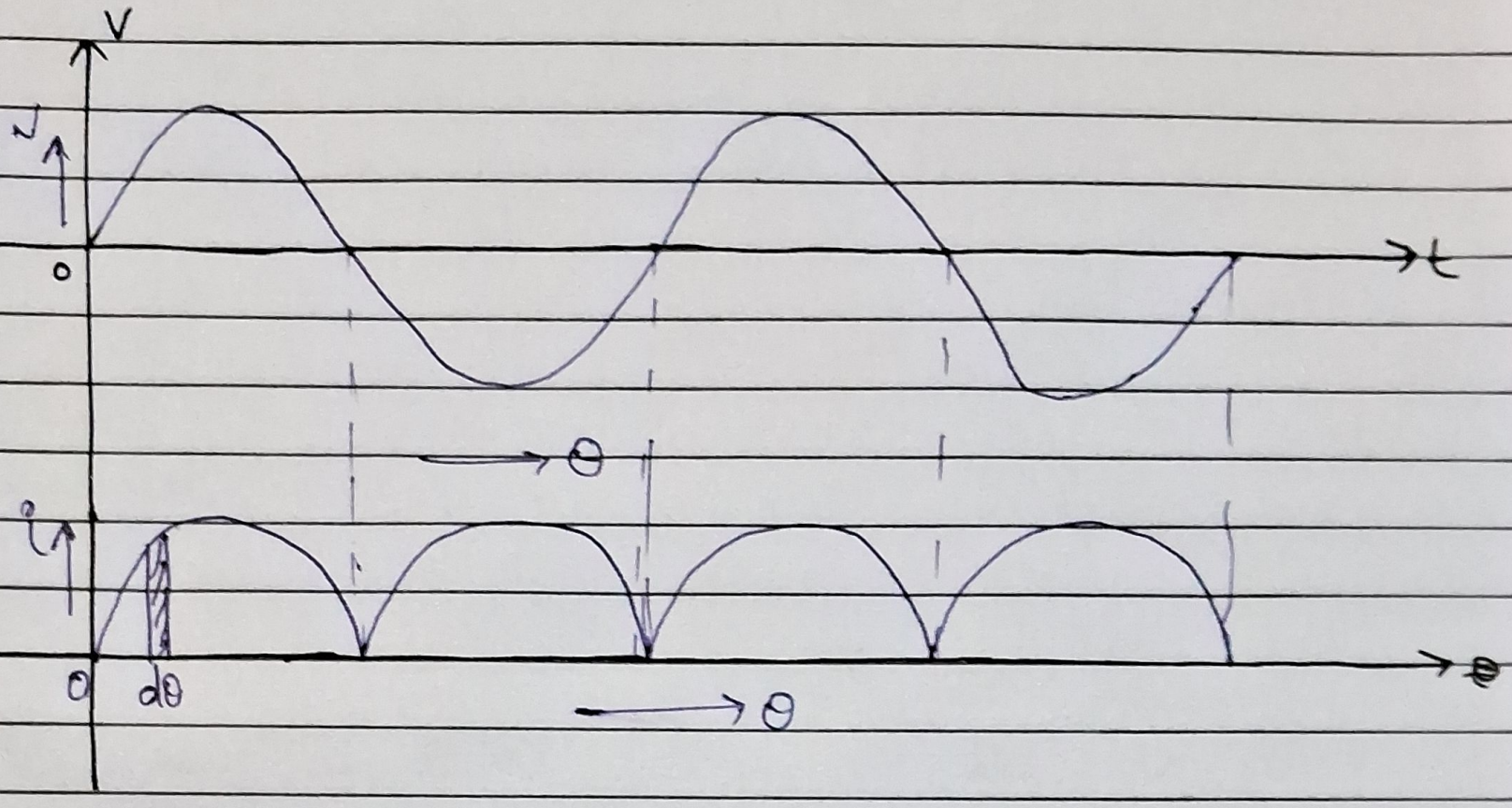

Full wave Rectifier

Working Method :→

During the first half cycle of the input voltage, the terminal A is positive with respect to O while B negative with respect to O. Diode first is forward bias and conduct while diode second is reverse bias and does not conduct, the current flow through $R_L$ from D TO O. During the second half cycle A is negative and B is positive with respect to O Thus diode first is reverse bias and diode second is forward Biased. The current through $R_L$ is in the same direction as during the first half cycle. The resulting output current is a continuous series.

As we are getting output in positive half as well as negative half AC input cycle, the rectifier is called a full wave rectifier. Obviously, this is a more efficient circuit for getting rectified voltage or current then a half wave rectifier.

Date.....




# Full wave Rectifier Eqn and values :→

Average Voltage, $V_{average} = \frac{2V_m}{\pi}$

Average Current, $I_{average} = \frac{2I_m}{\pi}$

RMS voltage, $V_{RMS} = \frac{V_m}{\sqrt{2}}$

RMS Current, $I_{RMS} = \frac{I_m}{\sqrt{2}}$

Ripple factor = 0.482
Maximum efficiency = 81.2 %
form factor = 1.11
Peak factor = $\sqrt{2}$

Center tap rectifier, Transformer utilization factor (TUF) = 0.693
Bridge tap rectifier, Transformer utilization factor (TUF) = 0.812



Teacher's Sign.....