

SUBJECT –PE&PLC

BRANCH-ELECTRICAL

SEMESTER-5th SEM

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BASICS OF POWER ELECTRONICS

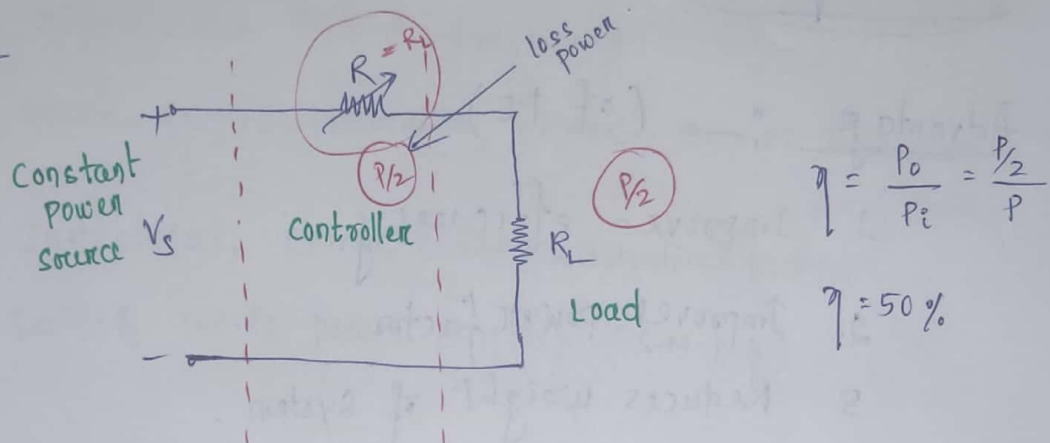
INTRODUCTION :-

→ Power Electronics is the technology to get desired output by the application of power semiconductor devices at high voltages and currents.

Motto of power Electronics

→ why do we need study of power Electronics ?

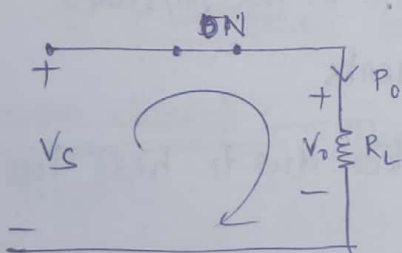
Example



Example:- ~~use switch~~ use switch.

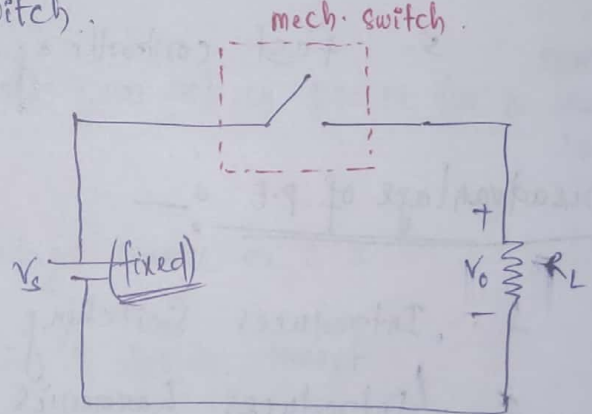
→ Let the time of one cycle is T .

(i) for $(0 - T/2) \rightarrow$ switch ON.



$$\boxed{V_o = V_s}$$

$$\boxed{i_o = i_s}$$

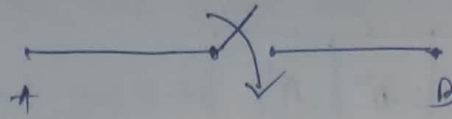


(ii) for $(T/2 - T) \rightarrow$ switch \rightarrow OFF

So, Load across power $P_o = \frac{V_o^2}{R}$ Watt.

POWER ELECTRONIC DEVICES :-

1. Mechanical switch.



Types :-

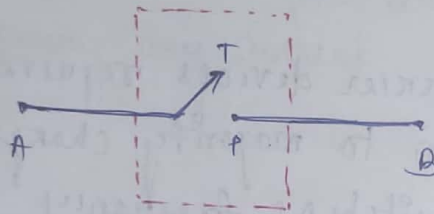
(i) single pole single through (SPST) switch.

(ii) single pole double " (SPDT) switch

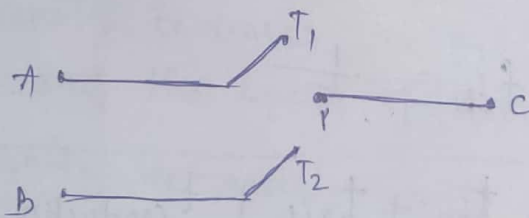
(iii) Double pole " " (DPDT) switch.

(iv) Double pole single " (DPST) switch.

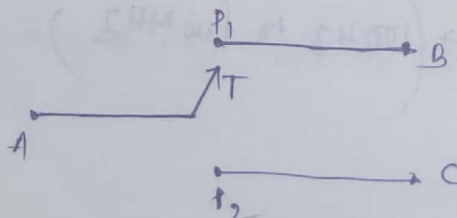
(1) SPST :-



(ii) SPDT :-



(iii) DPST :-

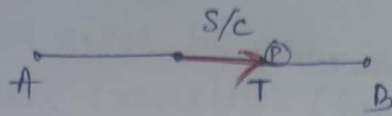


NOTE :-

A mechanical switch, can operate in either direction of current and can block any polarity of voltage.

Analysis of mechanical switch :-

(i) Let us assume \rightarrow switch is ON.

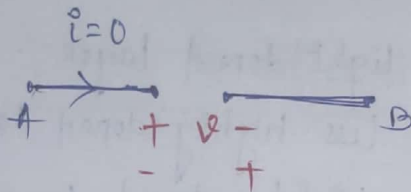


in ideal case,

the Resistance at switch ON $= 0 \Omega$.

\approx very low value

(ii) Let us assume \rightarrow mech. switch \rightarrow OFF

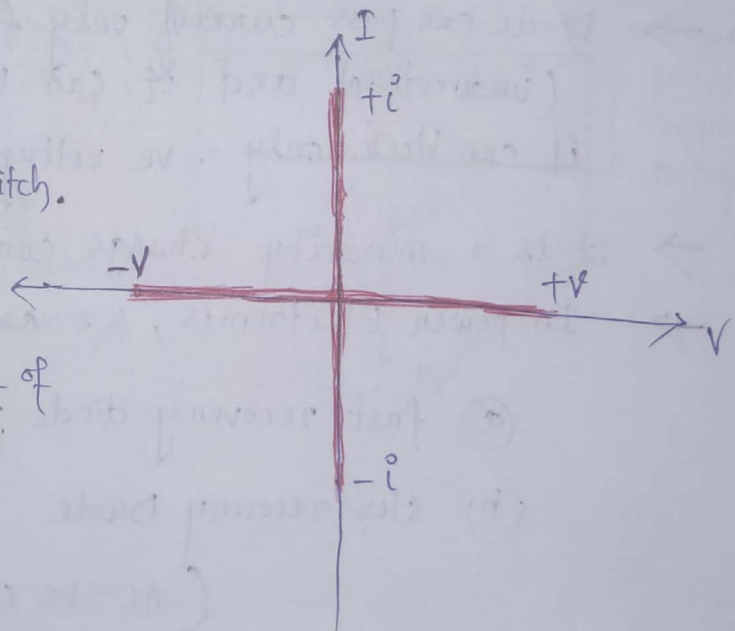


V-I characteristics of Ideal Mech. Switch :-

* Bidirectional ^(mech.) switch.

* Switch will be a bipolar switch.

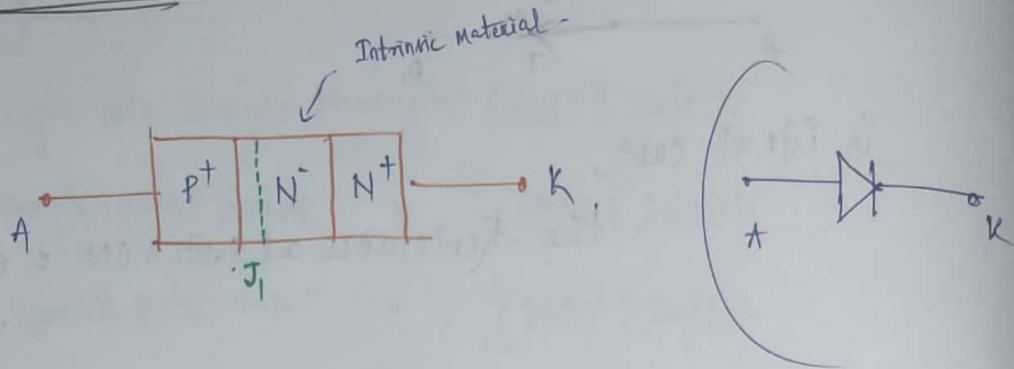
It can block voltage of either polarity.



Drawbacks :-

- (i) Bulky
- (ii) switching freqⁿ low
- (iii) manual operator.

POWER DIODE :-



- It has two terminal named as Anode and cathode respective
- It has three layers → P, N⁻ and N⁺
 - N⁻ → light doped layer
 - P → less highly doped layer
 - N⁺ → highly doped layer
- It has single junction (J).
- Diode can pass current only from Anode to cathode (unidirectional) and it can block only -ve voltage so it can block only -ve voltage so it is unipolar device
- It is a minority charge carrier device
- In power Electronics, we can use two types of diode
 - (a) fast recovery diode (DC-AC/DC-DC converter)
 - (b) slow recovery Diode (AC-DC converter)

→ ~~fast~~ ^{slow} recovery diode will block high voltage and can pass high current and ~~slow~~ ^{fast} recovery diode are good for low voltage / current ratings.

→ We always use silicon diode in power electronics converter, because they offer low leakage current, And Never use germanium diode in power electronics converter.

→ Diode can never be the primary device of our power electronics converter. (because it is uncontrolled device).
(Doping low → voltage high)

→ Power diode (uncontrolled devices) are also called passive devices in power electronics Device.

→ Diode is a voltage biased device.

Analysis of Diode in different modes

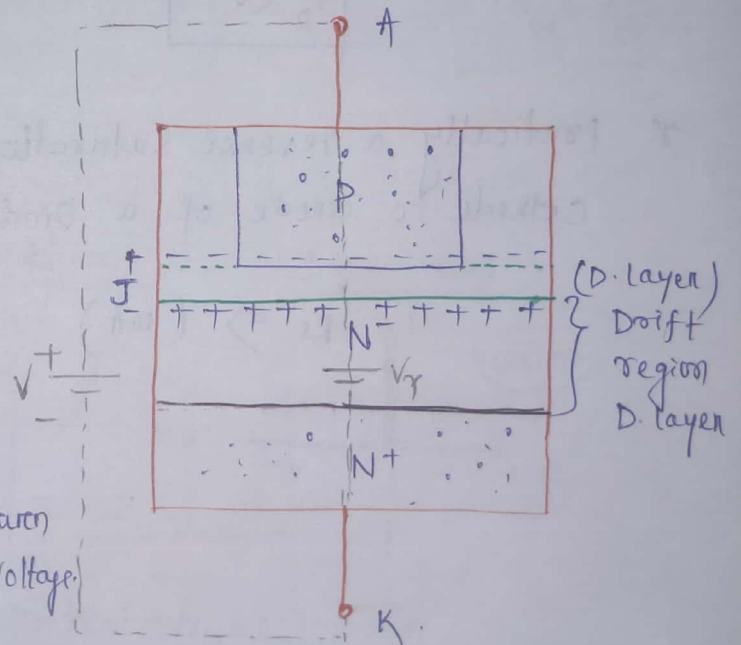
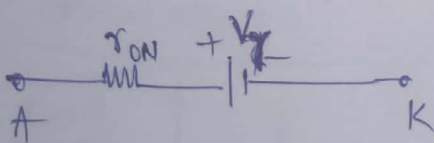
Case-1 :- let us assume.

$$V_{AK} > V_g$$

D → ON

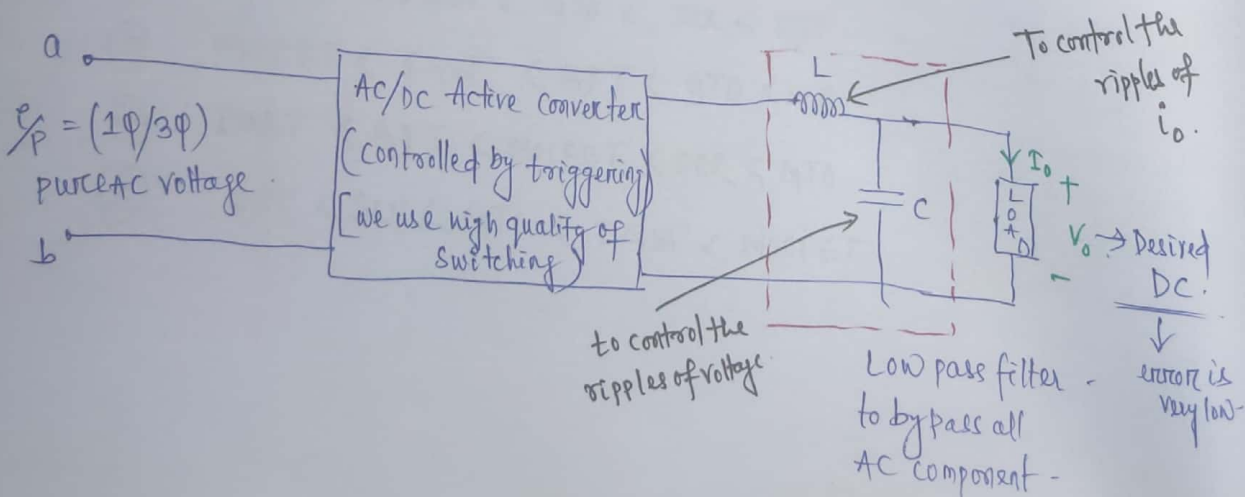
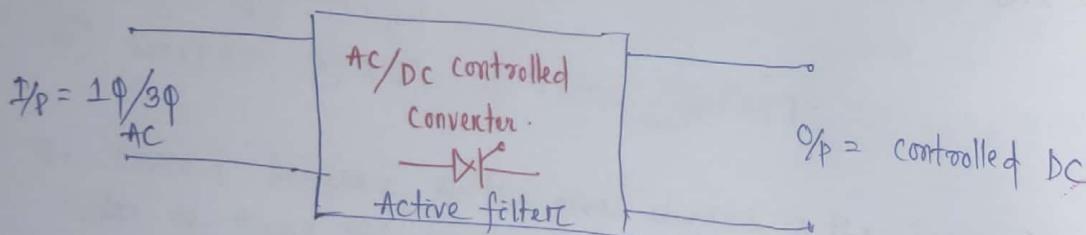
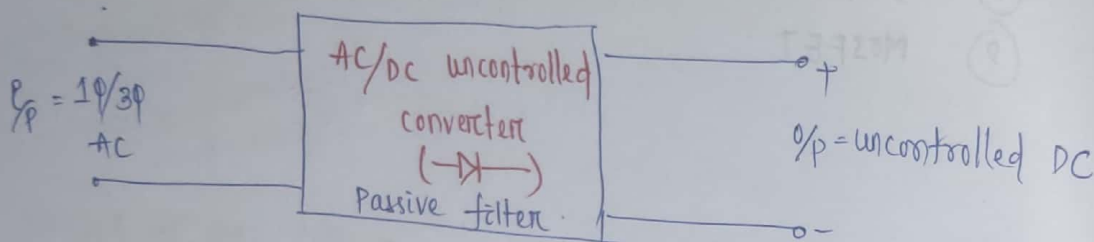
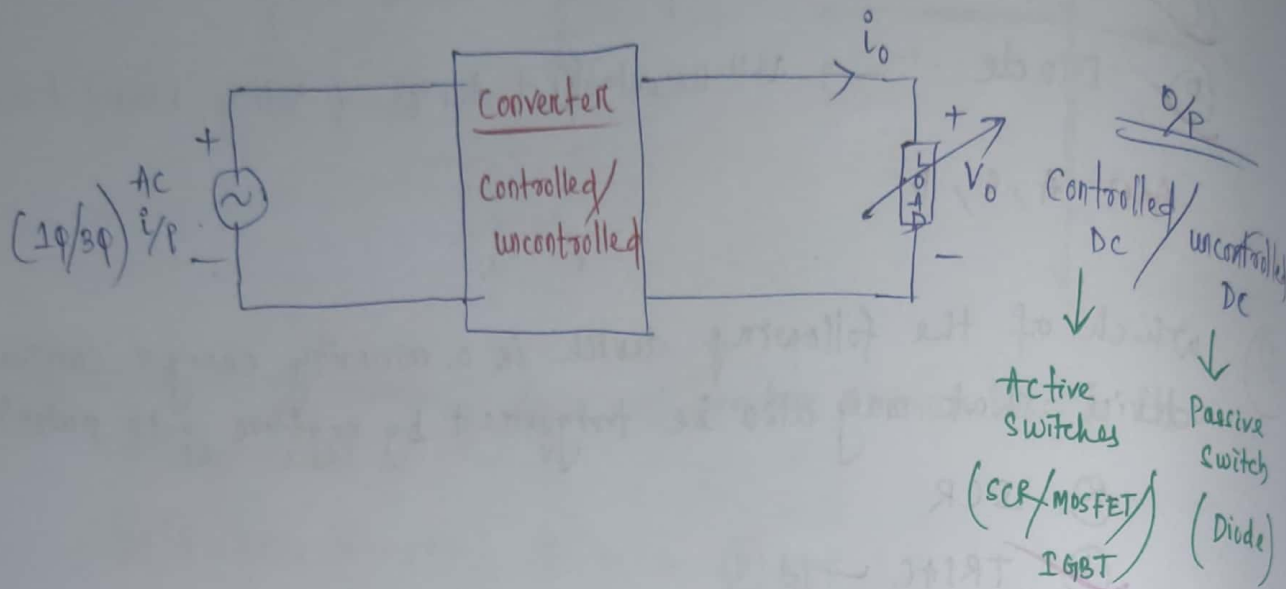


→ we can replace diode by a series combination of turn ON resistance and turn ON voltage.



PHASE CONTROLLED RECTIFIER

(AC-DC controlled/uncontrolled converter)

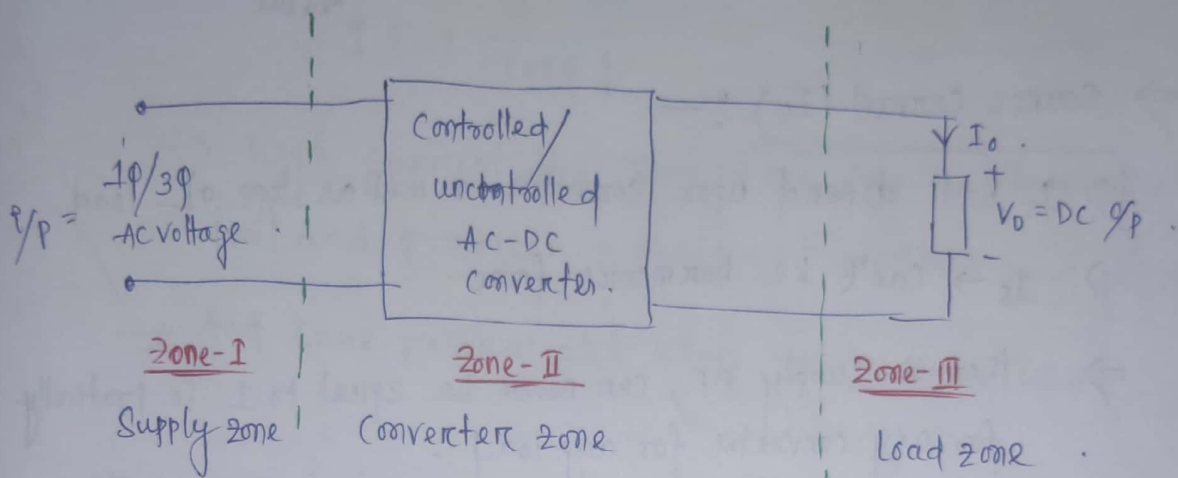


Phase Controlled Rectifier :-

→ With the help of phase controlled rectifier, we can control the phase voltage of supply of 1 ϕ or 3 ϕ and can achieve desired DC at load.

→ To control the phase voltage, we always required controlled devices for example :- SCR / IGBT / MOSFET etc.

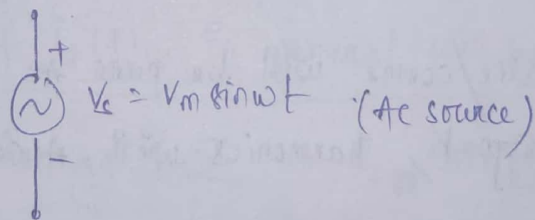
Analysis of phase controlled Rectifier in different zone :-



Zone-I Analysis :- (Supply zone)

→ We always use AC voltage (1 ϕ /3 ϕ) as a supply in AC-DC converter.

Let 1 ϕ supply voltage.



$V_s \rightarrow$ Independent AC voltage, never depend upon load and converter.

Let, $V_s = V_m \sin \omega t$ is harmonic free (Always).
↓
Max^m Volt. of supply.