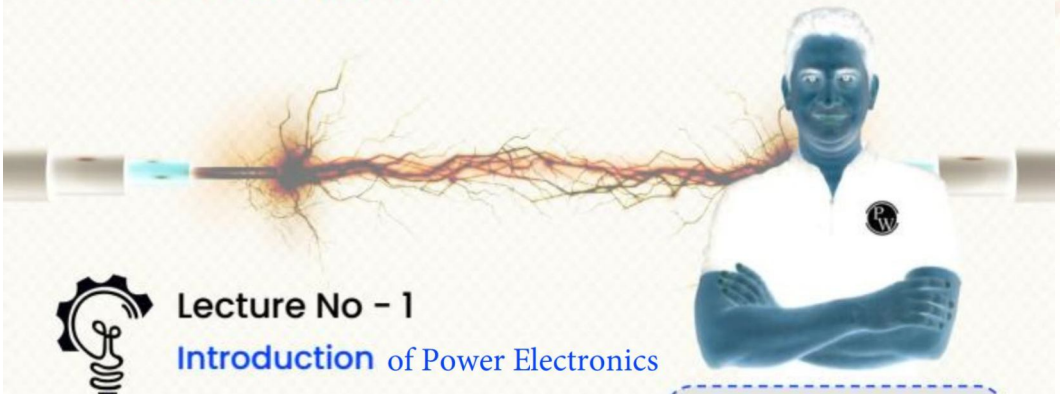
Electrical Engineering

Power Electronics



Lecture No - 1

Introduction of Power Electronics

By- Ajay Gupta Sir

1. What is power Electronics
2. Some application of P.E.
3. Classification of PSD

@AJAYGUPTASIRPW

Introduction to Power Electronics

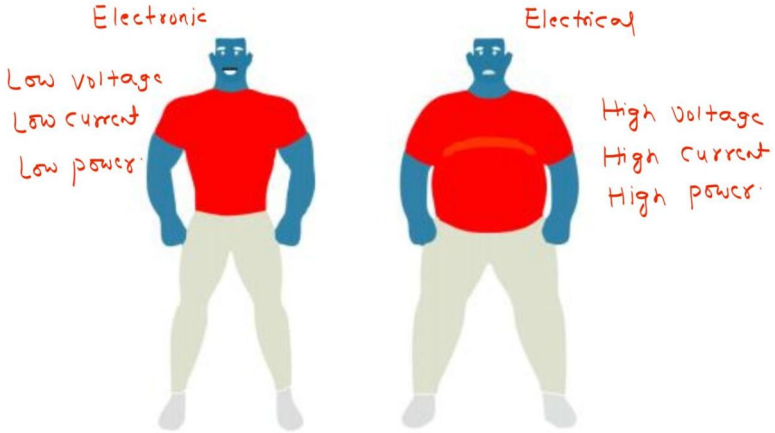
Power Electronics

Power Engineering
Electrical Engineering

Electronics Engineering

- Power Electronics is a subject that partially deals with electrical engineering & partially with electronics engineering.

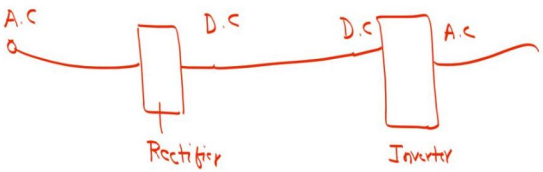
Introduction to Power Electronics

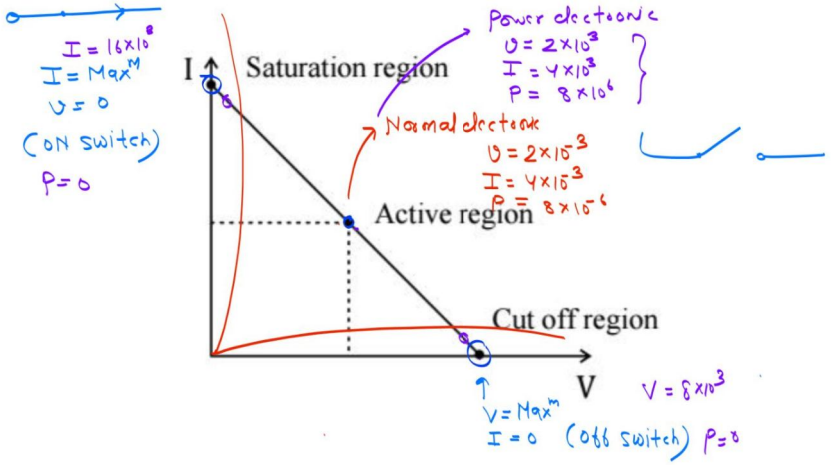


Introduction to Power Electronics

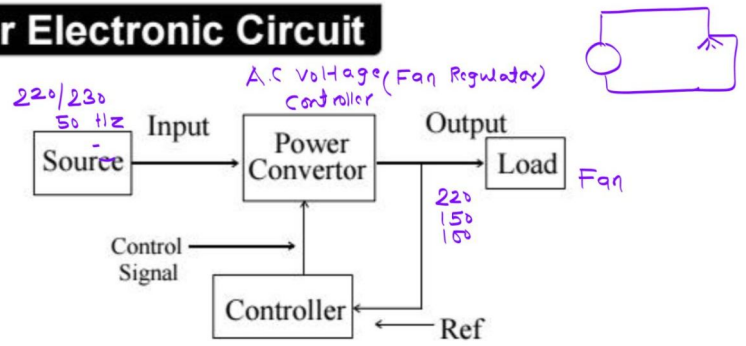
- In Power electronics, we will use electronic devices in electrical engineering application.
- In normal electronics, these devices operate in active (linear) region, but in Power electronics, these devices operate as a "switch" [in cut off region or saturation region].
- Power electronics deal with the control and conversion of Electrical power at high power level.

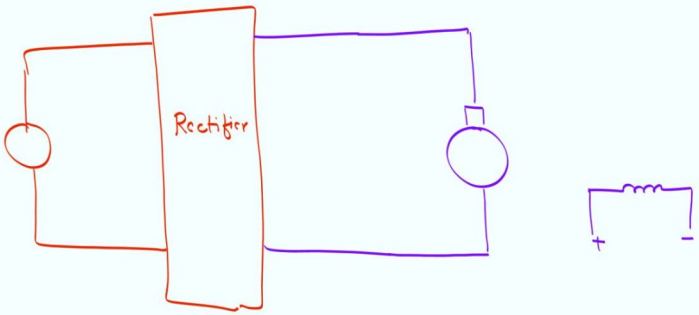
5V



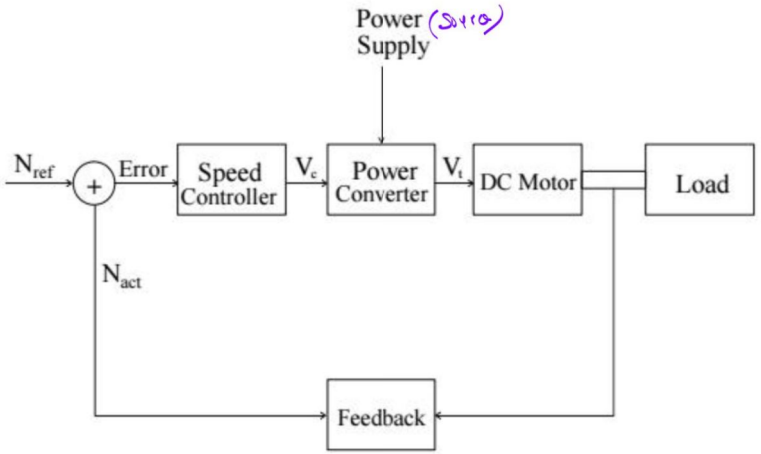


Power Electronic Circuit

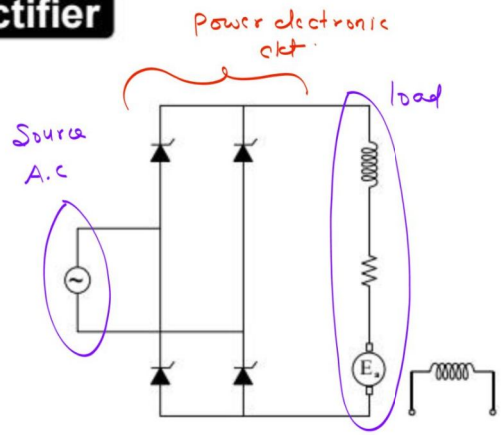


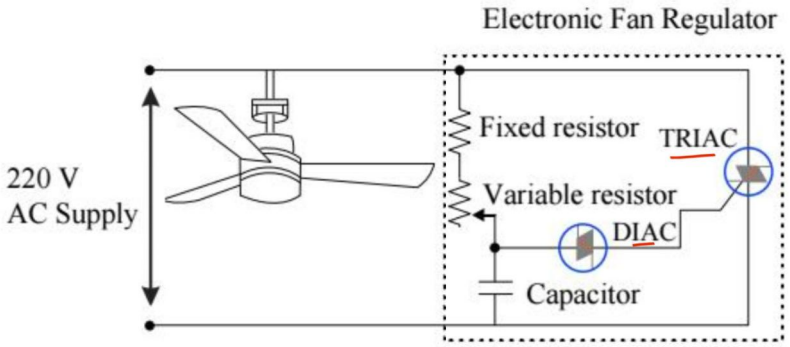


Power Electronic Circuit



Rectifier





Syllabus- Power Electronics

- Power Semiconductor Devices
- Rectifier (AC – DC)
- Chopper (Fixed DC- Variable DC)
- Inverter (DC – AC)
- AC voltage Controller (Fixed AC - Variable AC)
- Cycloconverter (Fixed AC → Variable AC Supply)
- Drives

Reference Books- Power Electronics

- Power electronics deal with control & conversion of electrical power at high efficiency.

Reference Books

1. Power Electronics- Converters, Applications and Design by Ned Mohan, Tore M. Undeland & William P. Robbins.
2. Power Electronics by Dr. P.S. Bimbhra.
3. Power Electronics by M D Singh & K B Khanchandani.

Power Semiconductor Devices

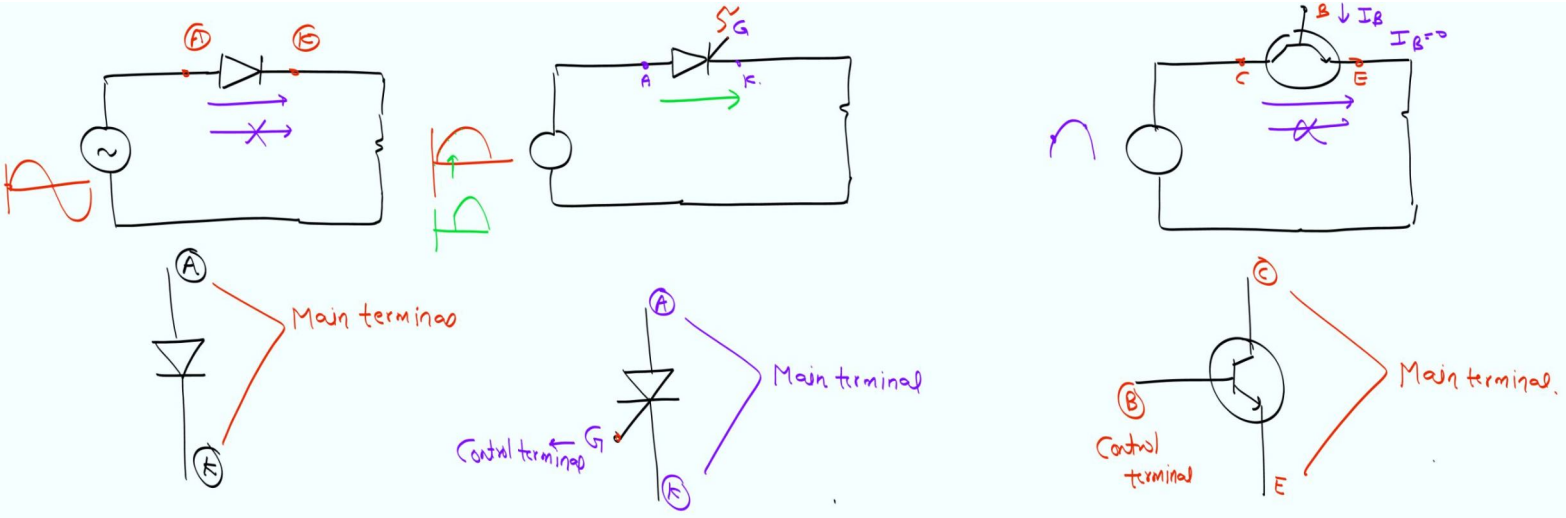
- It is electronic device made of semiconductor material, but its ratings are High.

Classification

1. Uncontrolled device
2. Semi controlled device
3. Fully controlled device

Power Semiconductor Devices

- In uncontrolled device, there is no control over turn on & turn off. Examples – Diode, DIAC
- In semi-controlled device, it may be turned on via "control terminal", but it can not be turned off via "control terminal". Example – SCR.
- The fully controlled device can be turned on as well as turned off by "control terminal". Examples - BJT, MOSFET, IGBT, GTO, TRIAC.



Power Semiconductor Devices

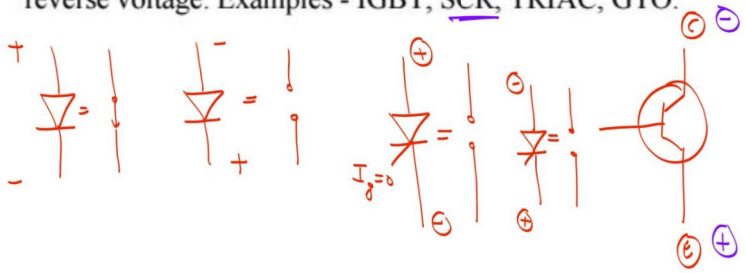
- Unidirectional device - Current can flow only in one direction. Examples - Diode, BJT, IGBT, SCR, GTO.
- Bidirectional device - Current can flow in both direction. Examples - MOSFET, RCT, DIAC, TRIAC.

Power Semiconductor Devices

- Unipolar device (Majority Carrier Device) - Current flows only due to majority carrier. Examples - Schottky device, MOSFET.
- Bipolar device (Minority Carrier Device) - Current flows due to both majority & minority carrier. Examples - Diode, BJT, IGBT, SCR, GTO, DIAC, TRIAC.

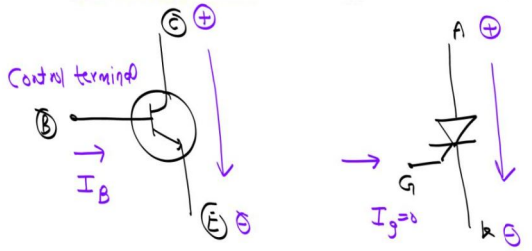
Power Semiconductor Devices

- Unipolar Voltage Blocking Capacity- It block either, forward voltage or reverse voltage. Examples - Diode, BJT, MOSFET, RCT.
- Bipolar Voltage Blocking Capacity - It blocks forward voltage as well as reverse voltage. Examples - IGBT, SCR, TRIAC, GTO.

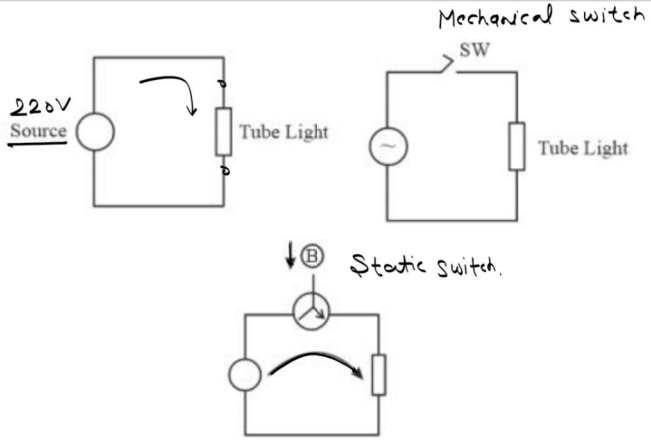


Power Semiconductor Devices

- Continuous control signal device - It requires continuous signal at control terminal to keep it ON. Examples - BJT, MOSFET, IGBT.
- Latching device - Examples – SCR, GTO, TRIAC. (it does not require continous signal at control terminal.)



Power Semiconductor Devices as Switch



Power Semiconductor Devices as Switch

- Power semiconductor devices may work as a static switch. The switch has two stable states -
  1. On State → (Conduction) (Current is conducting (flowing)
  2. Off State → (Blocking) (Current is not flowing. i.e it blocks the supply voltage)

2 Minutes Summary

→ What is power electronics.

→ Classification of PSD.

→ Static Switch.

THANK YOU

Electrical Engineering

Power Electronics

Lecture No - 2

Introduction of Power Electronics

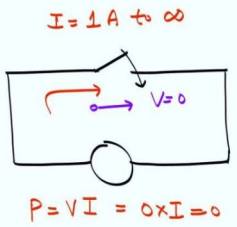
By- Ajay Gupta Sir

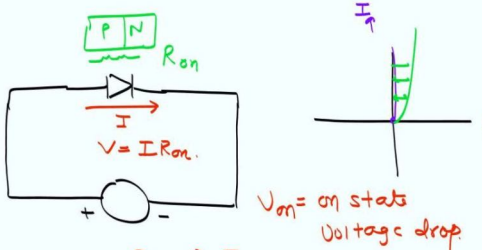
1. What is power Electronics ✓
2. Some application of P.E. ✓
3. Classification of PSD ✓

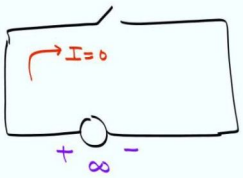
1. Ideal switch and Practical switch ✓
2. Mode of operation of switch ✓
3. Conduction mode ✓
4. Blocking Mode ✓
5. Computation of loss in P.E. ✓

Ideal Switch	Practical Switch
1. In conduction state, Ideal switch can handle very large amount of current, approx. up to ∞.	1. Practical switch can handle the current maximum up to it's current rating.
2. In conduction state, the voltage drop across switch should be zero.	2. In practical switch, "on state voltage drop" exists due to "on state resistances" of the switch $V_{on} = R_{on} I$.
3. Conduction power loss is zero in Ideal switch.	3. Conduction power loss is finite.
4. In Ideal switch, no current flows in blocking state	4. In practical switch, small amount of "leakage current" flows.

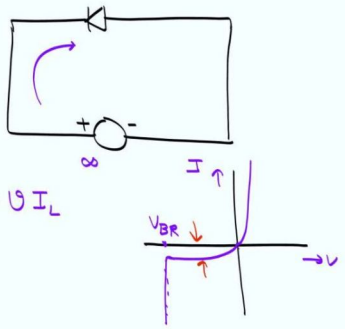
Ideal Switch	Practical Switch
5. The voltage blocking capacity should be very high, approx. up to ∞ .	5. The voltage blocking capacity depends upon its voltage Rating.
6. The Blocking power loss is equal to zero.	6. The Blocking power loss is "finite".
7. The "turn on" & "turn off" time of Ideal switch are zero.	7. It has finite "Turn on" and "Turn off" time.
8. The switching energy loss is zero. Ult	8. It has finite switching energy loss.



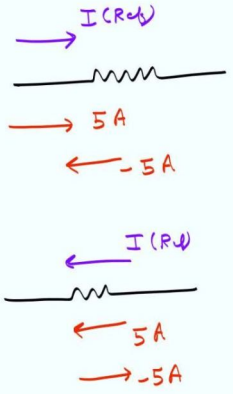


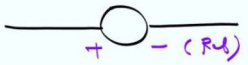


$P = VI = V \times 0 = 0$



$P = VI_L$





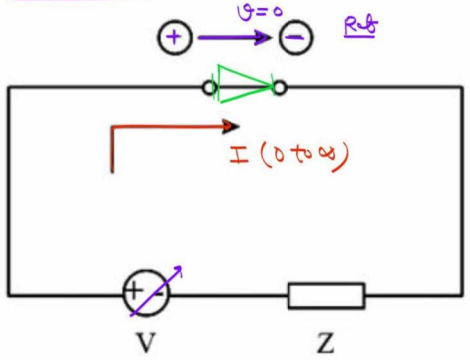
\+ − (Forward Voltage)

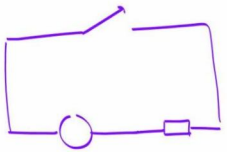
− + (Reverse Voltage)

Modes of Operation

- The switch may operate in 4 different modes –

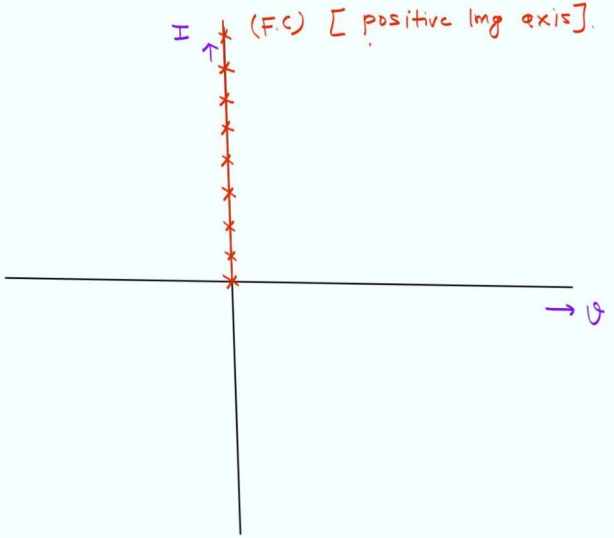
1. Forward conduction Mode(Ideal)





$I = \frac{V}{Z}$

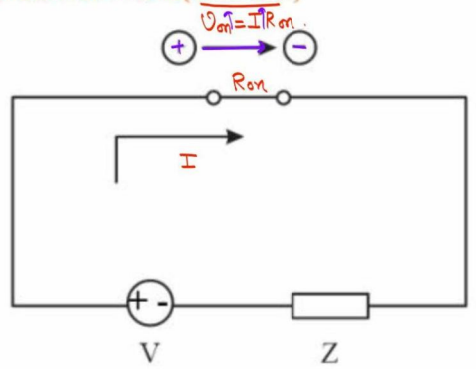
$I \propto V$



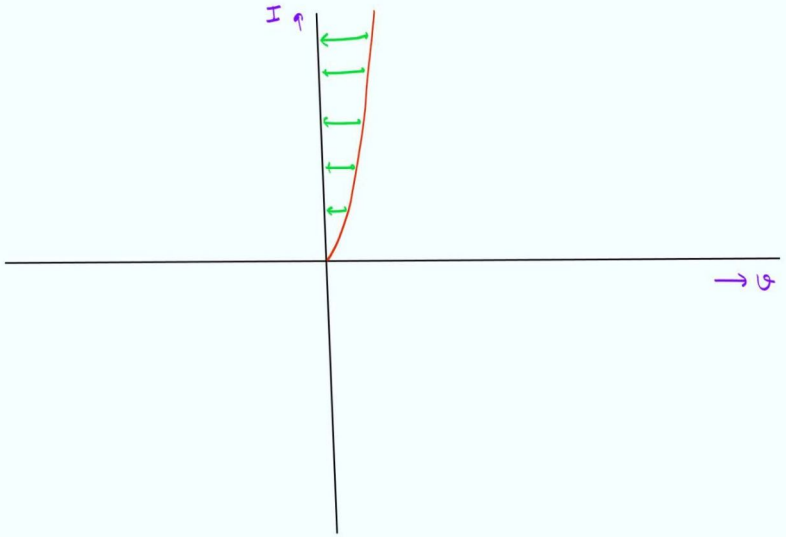
Modes of Operation

- The switch may operate in 4 different modes –

1. Forward conduction Mode(Practical)

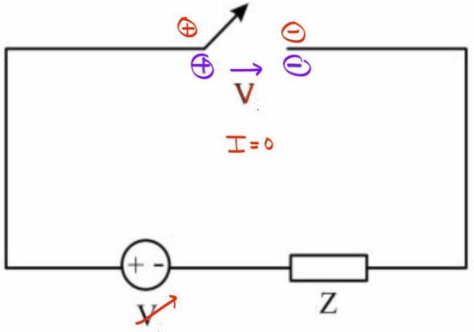


$I = \frac{V}{Z}$



Modes of Operation

2. Forward blocking Mode(Ideal)



$V = 0$ to ∞