

1. Power electronics

It may be defined as the Applications of solid state electronics for the control and conversion of electric power. It is based primarily on switching of power semiconductor devices.

High power products, heat controls, light controls, motor controls, Power supplies, Vehicle propulsion system ... etc.

2. SCR: It is a three terminal (Anode, Cathode, Gate) three junction and four layered semiconductor switching device (SILICON CONTROLLED RECTIFIER).

3. TRIAC: It is a three terminal, bidirectional semiconductor switching device. It has 3 terminals MT_1 , MT_2 , & Gate. It can control alternating current in load.
(*) It is equivalent to 2 SCR's connected in parallel but in reverse direction.

4. HOLDING CURRENT

It may be defined as the minimum value of anode current below which SCR stops conduction and returns to its off state.

LATCHING CURRENT

The Latching current is the minimum value of anode current required to keep the SCR in ON state after gate signal is removed (Latching current is more than holding current).

5. IGBT:

It combines the positive attributes of BJT's and MOSFET's. Better than BJT, it has lower ON-state voltage drop with high blocking voltage capabilities in addition to fast switching speed. Hence IGBT is preferred.

6. MOSFET - Metal Oxide Semiconductor field Effect Transistor

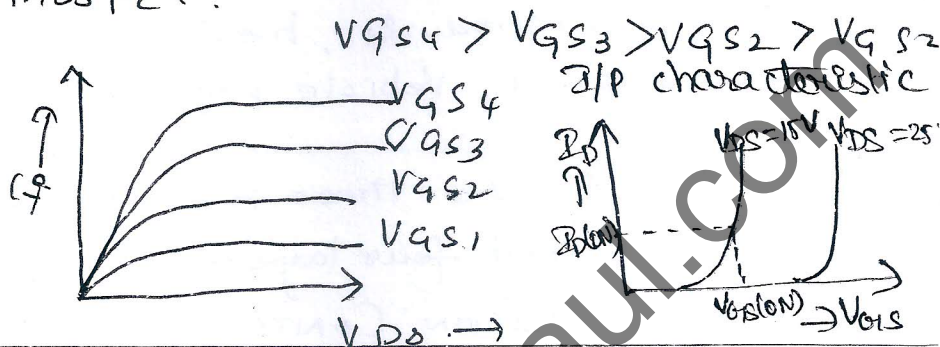
It is a very fast switching transistor. It has three terminals called (Drain (D), source (S) and gate (G)).

It is a Voltage Controlled Device, UNIPOLAR device.

Types: N-channel MOSFET

P-CHANNEL MOSFET.

O/P CHARACTERISTICS:



8) CHOPPERS: It is a static device that converts the Input DC voltage into fixed or variable DC o/p voltage.

APPLICATIONS: Trolley cars, Marine hoists, Forklift vehicles, Mine haulers, Electric automobiles.

CONTROL STRATEGIES:

- 1) Time ratio control
 - a) Constant frequency control
 - b) Variable frequency control

2) Current limit control (CLC)

9) PWM:

It is the most efficient method of controlling the gain. It is to incorporate PWM control within the inverter. In PWM, the o/p vt can be varied by changing the ON pulse width of the switching devices.

- Techniques:
- 1) Single-pulse width modulation
 - 2) Multi-pulse width modulation
 - 3) Sinusoidal pulse width modulation
 - 4) Modified Sinusoidal pulse width modulation
 - 5) Phase displacement control.

10. FREE WHEELING DIODES:

freewheeling diodes is connected across load in reverse direction. The energy stored in load inductance is fed back to load through freewheeling diode. It improves load current waveform and provides higher DC output voltage.

12. Duty cycle:

$$\alpha = \frac{T_{ON}}{T} = \text{duty cycle, where } T = T_{ON} + T_{OFF}$$

The load voltage can be controlled by varying duty cycle α . The load voltage is independent of load current.

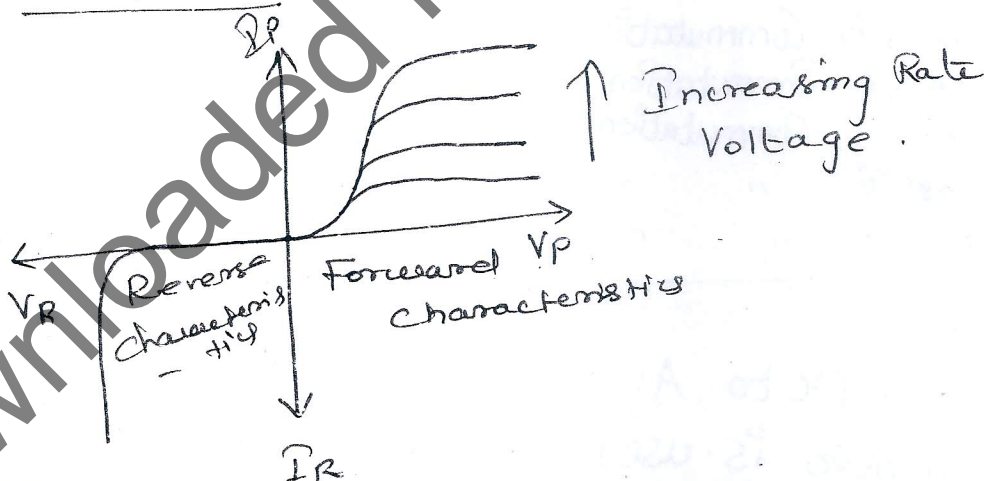
13. BUCK REGULATOR:

In a buck regulator, the average output voltage V_o is less than the DC input voltage V_s .

BOOST REGULATOR:

The output voltage is greater than the input voltage. Boost regulator can step up the voltage without a transformer.

14. IGBT CHARACTERISTICS



15. APPLICATIONS OF IGBT:

- AC motor drives
- DC to DC ^{power} supplies i.e., choppers
- UPS Systems.
- Harmonic Compensators

14. Voltage controlled device:

16. Firing angle:-

A firing angle may be defined as the angle measured from the instant that gives the largest average output voltage to the instant it is triggered.

17. Snubber circuit:-

A Snubber circuit consists of a series combination of resistance R_s and capacitance C_s in parallel with the thyristor. Capacitance is used to prevent unwanted dv/dt triggering of the SCR.

18. Commutation:

Commutation is defined as the process of turning-off a thyristor once thyristor starts conducting, SCR gate loses its control over the device, therefore, external means may have to be adopted to commutate the thyristor.

Types:

- CLASS A Commutation - Load Commutation
- CLASS B Commutation - Resonant Pulse Commutation.
- CLASS C Commutation - Complementary Commutation.
- CLASS D Commutation - Impulse Commutation
- CLASS E " " - External Pulse Commutation
- CLASS F " " - Line Commutation

19. Inverter:

DC to AC Converters are known as Inverters.

An inverter is used to change the DC input voltage to a symmetrical AC output voltage of desired magnitude and frequency.

Applications:

- Aircraft Power Supplies
- Induction heating
- uninterruptible Power Supplies
- Speed control of AC motors
- High voltage DC transmission

1) Application of SCR:

- * AC to DC Converter
- * AC voltage converter
- * Electronic Circuit breaker

2) Application of MOSFET

DC choppers,
low power UPS,
SMPS,
Brushless DC motor drives

3) Application of BJT

DC to AC converter
Induction motor drives
UPS
SMPS
Chopper

4) Pinch-off voltage:

When gate-source is reverse biased in n-channel MOSFET the channel is depleted. A pinch off V_t , is reverse gate source V_t at which the channel is completely depleted & no drain current flows through the channel.

5) Application of MOSFET: PHASE controlled converters:

DC motor drives
Battery charges
UPS systems
HVDC transmission
DC traction drives

6) SMPS:

The SMPS use DC choppers. The SMPS switches the dc input voltage using the techniques to provide regulated dc o/p V_t . The SMPS also use filter at the o/p to provide ripple free and smooth voltage.

7. PURPOSE OF CONNECTING diode in antiparallel with thyristors in Inverters:

Normally in reverse V_b across the thyristor to turn it off. The antiparallel diode conducts due to this reverse voltage. This diode conduction serves two purposes:

i) The conduction of diode imposes reverse bias across the thyristor.

ii) Excess energy stored in commutation circuit is fed back to source or load.

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