

**UNIT-I**  
**POWER SEMI-CONDUCTOR DEVICES**

**1. What is power electronics?**

Power electronics is a subject that concerns the applications electronics principles into situations that are rated at power level rather than signal level. It may be defined as a subject deals with the apparatus and equipment working on the principle of electronics but at rated power level.

**2. Give the applications of power electronics.**

Aerospace Commercial Industrial Telecommunications

**3. Define latching current and Holding current. (M/J 2016)(M/J 2014)(NOV/DEC2012)**

The latching current is defined as the minimum value of anode current which it must attain during turn on process to maintain conduction when gate signal is removed.

The holding current is defined as the minimum value of anode current below which it must fall to for turning off the thyristor.

**4. What is a snubber circuit?(M/J2013)(N/D2013)(N/D2015)(N/D2016) (N/D2013)(M/J2009) (N/D2008)**

It consists of a series combination of a resistor and a capacitor in parallel with the thyristors. It is mainly used for  $dv/dt$  protection.

**5. What are the advantages of GTO over SCR?(A/M2015)(A/M2015) (N/D2015)(A/M2017)**

- a. Elimination of commutation of commutating components in forced commutation, resulting in reduction in cost, weight and volume.
- b. Reduction in acoustic noise and electromagnetic noise due to elimination of commutation chokes.
- c. Faster turn-off, permitting high switching frequencies.
- d. Improved efficiency of the converters.

**6. What are the different methods to turn on the thyristor?**

- Forward voltage triggering
- Gate triggering
- $dv/dt$  triggering
- Temperature triggering
- Light triggering

**7. What is meant by commutation? (APRIL/MAY2017)(APRIL/MAY2018)**

It is the process of changing the direction of current flow in a particular path of the circuit. This process is used in thyristors for turning it off.

- a. Natural commutation
- b. Forced commutation

**8. What is meant by natural commutation?**

Here the current flowing through the thyristor goes through a natural zero and enable the thyristor to turn off.

**9. What is meant by forced commutation?**

In this commutation, the current flowing through the thyristor is forced to become zero by external circuitry.

**10. List the various forced commutation techniques used to turn off the SCR.(Nov/Dec2013)**

- Self commutation
- Impulse commutation
- Resonant pulse commutation
- Complementary commutation
- External pulse commutation
- Load side commutation
- Line side commutation

**10. Why IGBT is very popular nowadays? (MAY/JUNE2012) (Nov /Dec2017)**

- Lower gate requirements
- Lower switching losses
- Smaller snubber circuit requirements

**11.State the advantages of IGBT over MOSFET. (Nov/dec2008)**

Low on state power loss  
 Used for high power applications  
 Lower gate drive requirements  
 Small snubber circuit requirements

**12.Distinguish between SCR and TRIAC. (Nov/Dec2014)(May/June2009)**

S.No	SCR	TRIAC
1	It is a unidirectional device	It is a bidirectional device
2	SCR can be triggered with positive polarity voltage	TRIAC can be triggered with positive or negative polarity voltage.
3	High dv/dt rating	Low dv/dt rating
4	Reliability is more	Reliability is less

**11. Write down the applications of IGBT?**

- AC and DC motor drives
- UPS systems
- Power supplies
- Relays and Contactors

**12. Compare Power MOSFET with BJT.(May/June 2014)**

S.No	Power MOSFET	BJT
1	Lower Switching loss	Higher switching loss
2	high on state resistance so more conduction losses	lower conduction losses
3	Voltage controlled device	Current controlled device
4	It has positive temperature coefficient	It has negative temperature Coefficient

**13. Classify power semiconductor devices give examples.**

- Diodes: power diodes
- Thyristors: SCR
- Control switches: BJT, MOSFET and IGBT

**14. What are the types of power transistors?**

- Bipolar Junction Transistor (BJT)
- Metal Oxide Semiconductor Field Effect Transistor (MOSFET)
- Insulated Gate Bipolar Transistor (IGBT)

**15. How can a thyristor turned off?**

- A thyristor can be turned off by making the current flowing through it to zero.

**16. What losses occur in a thyristor during working conditions?**

- Forward conduction losses

- Loss due to leakage current during forward and reverse blocking.
- Switching losses at turn-on and turn-off.
- Gate triggering loss.

**17. Define circuit turn off time of SCR( (Nov /Dec2011)**

- It is defined as the time during which a reverse voltage is applied across the thyristor during its commutation process.

**18. What is the turn-off time for converter grade SCRs and inverter grade SCRs?**

- Turn-off time for converter grade SCRs is 50 – 100 ms turn-off time for converter grade SCRs and inverter grade SCRs and for inverter grade SCRs is 3 – 25 nsec.

**19. Define forward break over voltage.**

When anode is positive w.r.to cathode with gate current open, the junction J1 & J3 are forward biased but J2 is reverse biased. When the forward voltage is increased junction J2 will have an avalanche breakdown at a voltage. This voltage is called forward break over voltage.

**20.. Define reverse break over voltage.**

When cathode is positive w.r.to anode with gate current open, the junction J1 & J3 are reverse biased but J2 is forward biased. When the reverse voltage is increased junctions J1 & J3 will have an avalanche breakdown at a voltage. This voltage is called as critical breakdown voltage Vbr.

**21. What is the relation between  $\alpha$  and  $\beta$ ?**

$$\beta = \frac{\alpha}{1 - \alpha} \quad \alpha = \frac{\beta}{1 - \beta}$$

**22. IGBT is a voltage-controlled device. Why?**

Because the controlling parameter is gate-emitter voltage.

**23. Power MOSFET is a voltage-controlled device. Why?**

Because the output (drain) current can be controlled by gate-source voltage.

**24. Power BJT is a current controlled device. Why?**

Because the output (collector) current can be controlled by base current.

**25. What are the different types of power MOSFET?**

N-channel MOSFET  
P-channel MOSFET

**26. Why triac is not popular as compared to SCR? Justify(Nov /Dec2017)( MAY/JUNE2009) (NOV/DEC2014)**

Triac have low  $dv/dt$  rating compared to SCR.

Since triac can be triggered in either direction, a trigger circuit with triac needs careful consideration.

TRIAC are available in large rating compared to SCR.

Reliability of triac is less than that of SCR'

**27.What is the difference between power diode and signal diode?**

S.No.	Power diode	Signal diode
1.	Constructed with n-layer, called Drift region between p+ layer and n+ layer.	Drift region is not present.

2.	The voltage, current and power ratings are higher.	The voltage, current and power ratings are lower.
3.	Power diodes operate at higher switching speed.	Lower switching speed.

**28. What is the relation between  $\alpha$  and  $\beta$ ?**

$$\beta = \frac{\alpha}{1 - \alpha} \quad \alpha = \frac{\beta}{1 - \beta}$$

**29. Define hard-driving or over-driving.**

When gate current is several times higher than the minimum gate current required, a thyristor is said to be hard-fired or over-driven. Hard - firing of a thyristor reduces its turn-on time and enhances its di/dt capability.

**30. Mention the advantages of RC triggering over R triggering. (APRIL/MAY2018)**

- i) A large variation in the value of firing angle can be obtained in RC network by changing the phase and amplitude of gate current.
- ii) The firing angle can be controlled from  $0^\circ$  to  $180^\circ$  in RC triggering whereas in R triggering it can be controlled upto  $90^\circ$  only.

**31. Specify the basic features of IGBT.**

IGBT stands for Insulated gate bipolar transistor.

IGBT is a new development in the area of MOSFET technology. It combines the advantages of BJTs and MOSFETs.

IGBT has high input impedance like MOSFET and low on state conduction loss as in a BJT.

IGBT is free from second breakdown problem like BJT.

**32. What are the drawbacks of GTO? (Nov/Dec2012)**

- Magnitude of latching and holding current is more in a GTO.
- On state voltage drop and associated loss is more in a GTO.
- Due to the multicathode structure of GTO, triggering gate current is higher than the required for a conventional thyristor.

**What is meant by current commutation of SCR? (Nov/dec2014)**

The commutating components L & C are used in order

## PART-B

1. Explain the working of a current commutation technique. (April/May2018)(N/D2011)

2. Describe the UJT triggering circuit with neat sketch. (April/May2018)

**3. Explain the Static and Switching Characteristics of IGBT. (Nov/Dec2017)(Nov/dec2014)(N/D2013)(N/D2012)**

**4. Explain the Static and Switching Characteristics of MOSFET. (Nov/Dec2017)(May/June2014)(N/D2014)**

5. Explain Why triac is rarely used in I Quadrant with negative pulse and in III Quadrant with positive pulse. (Nov/Dec2017)

**6. Explain the construction and switching characteristics of SCR. (April/May2017)(Nov/Dec2016)(N/D2013)(N/D2011)**

7. Describe about the operating principle of MOSFET and Driver & Snubber circuit for MOSFET. (April/May 2017) (N/D 2008)

8. Explain the structure, different modes of operation and static & dynamics characteristics of TRIAC. (May/June 2016) (N/D 2008)

9. Explain the operating principle of a thyristor in terms of the "two transistor analogy" May/June 2016) (May/June 2014)

10. Discuss the different turn on methods of SCR with its turn on characteristics (N/D 2014)

11. Compare the performance characteristics of MOSFET and IGBT (8) (M/J 2009)

12. Briefly discuss the V/I Characteristics of SCR (8) (M/J 2009)

13. Discuss the working of complementary commutation circuit of SCR with neat diagram and waveforms. (N/D 2013) (N/D 2012) (8)

14. Compare and contrast performance of SCR and MOSFET (N/D 2012). (8)

## UNIT-II

### PHASE-CONTROLLED CONVERTERS

1. What is meant by phase controlled rectifier?

It converts fixed ac voltage into variable dc voltage.

2. Mention some of the applications of controlled rectifier. (Nov/dec 2015)

- Steel rolling mills, printing press, textile mills and paper mills employing dc motor drives.
- DC traction.
- Electro chemical and electro-metallurgical process.
- Portable hand tool drives
- Magnet power supplies.
- HVDC.

3. What is the function of freewheeling diodes in controlled rectifier? (APRIL/MAY 2017) (NOV/DEC 2016) (MAY/JUNE 2016)

- It prevents the output voltage from becoming negative.
- The load current is transferred from the main thyristors to the freewheeling diode, thereby allowing all of its thyristors to regain their blocking states.

4. What are the advantages of freewheeling diodes in a controlled in a controlled rectifier? (NOV/DEC 2016)

- Input power factor is improved.
- Load current waveform is improved and thus the load performance is better.

5. What is meant by delay angle?

The delay angle is defined as the angle between the zero crossing of the input voltage and the instant the thyristor is fired.

6. What is commutation angle or overlap angle? (NOV/DEC 2015)

The commutation period when outgoing and incoming thyristors are conducting is known as overlap period. The angular period, when both devices share conduction is known as the commutation angle or overlap angle.

7. Give an expression for average voltage of single-phase semiconverters.

Average output voltage  $V_{dc} = (V_m / \pi) (1 + \cos \alpha)$ .

8. What is meant by rectification mode in single phase fully controlled converter?

In single phase full converter  $\alpha < 90^\circ$  the voltage at the dc terminal is positive. Therefore, power flows from source to load & the converter operates as a rectifier. Source voltage is  $V_s$  & Current is positive. This is known as rectification mode.

9. What is meant by inversion mode of rectifiers? (NOV/DEC 2012) (M/J 2009)

In single phase full converter  $\alpha > 90^\circ$  the voltage at the dc terminal is negative. Therefore,

power flows from load to source & the converter operates as line commutated inverter. Source voltage  $V_s$  is negative & Current is positive. This is known as inversion mode or synchronous mode.

**10. What are the different types of controlled rectifier? (Nov/dec 2016)**

- According to input supply  
Single phase controlled rectifier & Three phase controlled rectifier
- According to Quadrant operation  
Semiconverter , full converter, dual converter
- According to no. pulses / cycle  
One pulse, two pulse, three pulse , Six pulse & twelve pulse converter.

**11. What are the differences between half controlled & fully controlled bridge rectifier?(May /june 2014)(April/May2018)(May/June2014)**

Half Controlled Bridge Rectifier

1. Power circuit consists of mixture of diodes & SCRs 2.It is one quadrant Converter 3.The Dc output voltage has limited control level. 4. Input power factor is more.

Full Controlled Bridge Rectifier 1.Power circuit consists of SCRs only 2.It is 2 quadrant Converter 3. The Dc output voltage has wider control level. 4. Input power factor is less.

**12. What is meant continuous current operation of thyristor converter?**

When a freewheeling diode is connected across the output, load current continuous flow through the load. Whenever the load voltage tends to go to negative, freewheeling diode starts conduct. As a result load current is transferred from SCR to freewheeling diode. This is called continuous current operation os thyristor converter.

**13. Define input power factor. .(Nov/Dec2017)**

It is defined as the ratio of the total mean input power to the total RMS input voltage – amperes.  
 $P.F = \frac{V_1 I_1 \cos \phi}{V_{rms} I_{rms}}$

**14.What is meant by phase control.(APRIL/MAY2017)(Nov/dec2014)**

In ac circuits the SCR can be turned ON by applying gate signal at any angle with respect to the applied voltage.

**15.What are the effects of Source Inductance.( MAY/JUNE 2016)(APR/MAY2015)**

The effects of source inductance is

- i) Lower the mean output voltage
- ii)To distort the output voltage and current waveforms
- iii)To modify the performance parameters of the converter

**16.What is Dual converter? Mention its functional mode of operation.(May/June2014)?**

When the polarities of output as well as current can be reversed ,then it is called dual converter .It operates in all 4 quadrants of  $V_O - I_O$  plane.They are 2 functional modes of a dual converter .One is non-circulating current mode and other is circulating mode.

**17.Why power factor of semiconverter is better than full converter?(Nov/dec2015)(Nov/dec2014)(N/D2012)**

For supplying given load,the semiconverter receives less reactive power due to freewheeling action when compared with full converter. Therefore ,the powerfactor is better in semiconverter.

**18.Mention the disadvantages of Dual converter with circulating mode of operation.(Nov/Dec2013)**

**19.What is meant by line commutated inverter?(Nov/Dec2011)**

**20.Define Distortion factor.(May/June2009)**

21. Write the expression of the output dc voltage in a single phase controlled rectifier. (N/D2008)

22. Define THD (total harmonic distortion) (N/D2008)

### PART-B

1. Discuss the operation of a 3 phase semiconverter with R load and also draw the output voltage waveforms for 30 degree and 90 degree (April/May2018)(Nov/dec2012)

2. Explain the working of single phase full converter for RL load discontinuous mode of operation with neat sketch and waveforms. (April/May2018) (Nov/dec2011) (April/May2015)

3. Explain the working of single phase full converter for RL load in the rectifying mode and inversion mode. Also derive the expression for average and rms voltage. (Nov/dec2013)

4. Describe the working of Dual converter (both 1 $\Phi$  & 3 $\Phi$ ) (April/May2017) (Nov/dec 2016) (M/J2016) (April/May2015) (May/June 2014)(N/D2014)(N/D2013)

5. Describe the working of 1  $\phi$  half wave converter in with RL load. And derive the expressions for average output voltage and rms output voltage. (April/May2017)(Nov/dec 2016) (M/J2016)

6. Discuss the effect of source of inductance on the performance of single phase full converter. (May/June 2014)(N/D2008)

7. Describe the working of 3  $\phi$  full wave converter in with R load. And derive the expressions for average output voltage and rms output voltage (Nov/Dec2017)(Nov/dec2011)(M/J2009)(N/D2008)

### UNIT-III

#### DC TO DC CONVERTER

1. What is meant by dc chopper? (Nov/dec2013)

A dc chopper is a high speed static switch used to obtain variable dc voltage from a constant dc voltage.

2. What are the applications of dc chopper? (APRIL/MAY 2017)(NOV/DEC2015) (NOV/DEC2014)

- Battery operated vehicles
- Traction motor control in electric traction.
- Trolley cars
- Marine hoists
- Mine haulers
- Electric braking.

3. What are the advantages of dc chopper?

High efficiency    Smooth acceleration    Fast dynamic response    Regeneration

4. What is meant by step-up and step-down chopper?

In a step- down chopper or Buck converter, the average output voltage is less than the input voltage. In a step- up chopper or Boost converter, the average output voltage is more than the input voltage.

5. Write down the expression for average output voltage for step down chopper.

Average output voltage for step down chopper  $V_0 = \alpha V_s$ ,  $\alpha$  is the duty cycle.

6. Write down the expression for average output voltage for step up chopper. Average output voltage for step down chopper  $V_0 = V_s / (1 - \alpha)$   $\alpha$  is the duty cycle.

**7. What is meant by duty-cycle? (May /JUNE 2016 )(NOV/DEC2015)**

Duty cycle is defined as the ratio of the on time of the chopper to the total time period of the chopper. It is denoted by  $\alpha$ .

**8. What are the different control strategies of DC chopper? (NOV/DEC2016)**

- Time Ratio Control (TRC)
- Current Limit Control method (CLC)

**9. What is meant by TRC? ( APRIL/MAY 2015)(NOV/DEC2013)(Nov/Dec2008)**

In TRC, the value of  $T_{ON} / T$  is varied in order to change the average output voltage.

**10. What are the two types of TRC?**

- Constant frequency control
- Variable frequency control

**11. What is meant by FM control in a dc chopper?**

In frequency modulation control, the chopping frequency  $f$  (or the chopping period  $T$ ) is varied. Here two controls are possible.

On-time  $T_{ON}$  is kept constant      Off period  $T_{OFF}$  is kept constant.

**12. What is the disadvantage of frequency modulated chopper? (NOV/DEC2017)**

- i) The chopping frequency has to be varied over a wide range for the control of output voltage. In frequency modulation the filter design is very difficult for wide range of frequency variation.
- ii) This type of control would generate harmonics at unpredictable frequency which would produce interference with signaling and telephone lines.

**13. What is meant by PWM control in dc chopper? (May /JUNE 2016)(NOV/DEC2015)**

In this control method, the on time  $T_{ON}$  is varied but chopping frequency is kept constant. The width of the pulse is varied and hence this type of control is known as Pulse Width Modulation (PWM).

**14. What are the different types of chopper with respect to commutation process?**

- Voltage commutated chopper.
- Current commutated chopper.
- Load commutated chopper.

**15. What is meant by Resonant converter ?(APRIL/MAY 2017) (April/may 2018)**

A converter operated with LC resonant is called Resonant converter

**16. What is the effect of load inductance on the load current waveforms in the case of DC chopper ? (APRIL/MAY 2017)**

- i) average output voltages should be reduced.
- ii) Reduced displacement factor
- iii) output current waveform also changed.

**17. What is meant by current limit control in a dc chopper?(April/may2018)(April/may 2015)**

Current limit control in chopper involves switching ON & OFF the chopper periodically so that load current is forced to remain between two limits  $I_{min}$  and  $I_{max}$  which means the chopper is turned on when current is minimum value and turned off when the current reaches or goes beyond the set limit value.

**18. What are the different classifications of chopper depending upon the direction of current and voltage?(Nov/Dec 2016)**

- i) Type A chopper or first quadrant chopper
- ii) Type B chopper or second quadrant chopper
- iii) Type C chopper or Two quadrant type B chopper
- iv) Type D chopper or Two quadrant type C chopper
- v) Type E Chopper or Four quadrant chopper.

**19. Distinguish between time ratio control and current limit control employed in a dc chopper. (NOV/DEC2015)(NOV/DEC2014).**

TIME RATIO CONTROL	CURRENT LIMIT CONTROL
In the time ratio control the value of $T_{on} / T$ is varied.	In this method, the chopper is switched ON & OFF so that the current in the load is maintained between two limits $I_0 \text{ min}$ and $I_0 \text{ max}$

**20. What are the circuit configuration used for SMPS?(May/June2014)**

**21. What is constant frequency control of chopper?(Nov/Dec2012)**

**22. Brief up the working of Four quadrant DC chopper.(Nov/Dec2012)**

**23. What are the advantages of SMPS over Phase controlled rectifiers.(Nov/Dec2011)**

**24. What is the use of resonant switching? (Nov/Dec2011)**

**25. What is meant by SMPS(M/J2009)**

#### **PART-B**

**1. Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. (16) (April/May2015)(N/D2014)(N/D2013)**

**2. Describe the principle of step-down chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. (16) (N/D2008)**

**3. Explain the working of Buck converter with aid of circuit diagram and necessary waveforms. Derive an expression for its output voltage. (16) (Nov/Dec2017)**

**4. Explain the working of Boost converter with aid of circuit diagram and necessary waveforms. Derive an expression for its output voltage. (16) (April/May 2018) (Nov/Dec2016)(N/D2012)(M/J2009) (N/D2008)**

**5. Explain the working of Buck-Boost converter with aid of circuit diagram and necessary waveforms. Derive an expression for its output voltage. (16) (May/June 2016) (April/May2015)(N/D2011) (M/J2009)**

**6. Explain the working of voltage commutated chopper with aid of circuit diagram and necessary waveforms. Derive an expression for its output voltage. 16 (April/May 2018) (Nov/Dec2016) (May/June 2016)**

**7. Explain the Steady state analysis of Step down chopper.(Nov/dec2017)**

**8. Explain the control strategies of Chopper.(April/May2017)**

**9. Write a short note on switch mode power supply.(6)(N/D2014)**

**10. Write a note on resonant switching(6)(N/D2013)**

**11. Explain with neat circuit diagram of one of the configuration of SMPS.(8)(N/D2013)**

**UNIT-IV  
INVERTERS**

**1. What is meant by inverter?**

A device that converts dc power into ac power at desired output voltage and frequency is called an inverter.

**2. What are the applications of an inverter?(May/June2016)**

- a. Adjustable speed drives
- b. Induction heating
- c. Stand-by aircraft power supplies
- d. UPS
- e. HVDC transmission

**3. What are the main classification of inverter?**

- a. Voltage Source Inverter
- b. Current Source Inverter

**4. Give two advantages of CSI.**

- a. CSI does not require any feedback diodes.
- b. Commutation circuit is simple as it involves only thyristors.

**5. How is the inverter circuit classified based on commutation circuitry?**

- a. Line commutated inverters.
- b. Load commutated inverters.
- c. Self commutated inverters.
- d. Forced commutated inverters.

**6. What are the applications of a CSI?(Nov/Dec2016)**

- a. Induction heating
- b. Lagging VAR compensation
- c. Speed control of ac motors
- d. Synchronous motor starting.

**7. What is meant by PWM control?**

In this method, a fixed dc input voltage is given to the inverter and a controlled ac output voltage is obtained by adjusting the on and off periods of the inverter components. This is the most popular method of controlling the output voltage and this method is termed as PWM control.

**8. What are the advantages of PWM control in inverters?(May/June2014)(Nov/Dec2013)(N/D12)**

The output voltage control in this method can be obtained without any additional components. With this method, lower order harmonic can be eliminated or minimized along with its output control. As higher order harmonics can be filtered easily, the filtering requirements are minimized.

**9. What is Harmonic Elimination by PWM?(APRIL/MAY2015)**

In the case of single pulse width modulation, the width of the pulse is adjusted to reduce the harmonic. In general the RMS value of the amplitude of harmonic voltages of a single pulse modulated wave is given by

$$V_{Ln} = 4V_s / \sqrt{2} n \sin Np/2$$

**10. What are the methods of reduction of harmonic content?**

- a. Transformer connections
- b. Sinusoidal PWM
- c. Multiple commutation in each cycle
- d. Stepped wave inverters

**11. Compare CSI and VSI. (April/may2018)( May/June2016)(May/June2014)**

S. No.	VSI	CSI
1.	Input voltage is maintained constant	Input current is constant but adjustable

2.	The output voltage does not depend on the load	The output current does not depend on the load
3.	The magnitude of the output current and its waveform depends on the nature of the load impedance	The magnitude of the output voltage and its waveform depends on the nature of the load impedance
4.	It requires feedback diodes	It does not requires feedback diodes
5.	Commutation circuit is complicated i.e. it contains capacitors and inductors.	Commutation circuit is simple i.e. it contains only capacitors.

**12. What is meant by space vector modulation? (April/may 2018)**

It is the most successful method to develop three phase sine wave voltage source inverter, in addition to control AC drives using Vector control. SVM is becoming popular form of pulse width modulation for voltage fed converter drives because of its superior harmonic quality and extended linear range of operation.

**13.) State the necessity of return current diodes in inverter. (NOV/DEC 2017)**

For inductive load, current  $I_o$  will not be in phase with voltage  $V_o$  and diodes are connected in antiparallel with thyristors will allow the current to flow when the main thyristors are turned off. These diodes are called feedback diodes.

**14.) What is the function of feedback diodes in bridge inverter? (NOV/DEC 2017)**

The diodes  $D_1$  and  $D_2$  which are connected in antiparallel with the thyristor carries the current when the thyristor are turned off. These diodes  $D_1$  and  $D_2$  are called feedback diodes.

**15.) Why thyristors are not preferred for Inverter? (April/MAY 2017)**

Thyristors requires extra commutation circuits for turn off which results in increased complexity of the circuit. For these reasons thyristors are not preferred for inverters.

**16.) What are the disadvantages of the harmonics present in the inverter? (April/MAY 2017)**

- i) Harmonics currents will lead to excessive heating in the induction motors. This will reduce the load carrying capacity of the motor.
- ii) If the control and regulating circuits are not properly shielded, harmonics from power ride can affect their operation and malfunctioning can result.
- iii) Harmonics current cause losses in the ac system and can even some time produce resonance in the system.

**17.) Define modulation index and what is its use. (NOV/DEC 2016)**

It is defined as the ratio between reference voltage to carrier voltage.  $MI = V_R/V_C$

18.)What is meant by voltage source inverter?(Nov/Dec2014)

19.)Write the advantages of resonant converters (.Nov/Dec2014)

20) What is the advantage of 120 degree mode over 180 degree mode of operation?(N/D2013)

21.)What is meant by current source inverter?(Nov/Dec2012)(Nov/Dec2011)(M/J2009)(N/D2008)

22.)Why is the series inverter so called? (Nov/Dec2011)

23.)List of advantage of multiple PWM over Single PWM technique.((M/J2009)

24.Mention the difference between sinusoidal PWM and modified sinusoidal PWM technique.(Nov/Dec2008)

### PART-B

1. Explain the operation of 3  $\phi$  bridge inverter for 120 degree mode of operation with aid of relevant phase and line voltage waveforms. (16)(April/May2018)  
(April/May2017)(May/June2016)(May/June2014)(Nov/Dec2012)(M/J2009)
2. State different methods of voltage control inverters. Describe about PWM control in inverter. (16) (April/May2017) (M/J2009)
3. Explain the operation of 3  $\phi$  bridge inverter for 180 degree mode of operation with aid of relevant phase and line voltage waveforms. (16) (Nov/Dec 2017)( Nov/Dec 2016)(N/D2014)(N/D2013)(N/D2011)(Nov/dec2008)
4. Explain the operation of 1  $\phi$  bridge inverter operation with aid of relevant waveforms and expression. (16)
5. Explain the SPWM and modified SPWM techniques for inverter switching. (April/May2018) (N/D2013)
6. Explain the operation of series Resonant Inverter.( (Nov/Dec 2017)
- 7.State different methods of voltage control inverters.Describe about PWM control in inverter. (April/May2017)
- 8 Comparison between voltage source inverter and current source inverter .( Nov/Dec 2016)
- 9 Explain any one method to reduce the harmonic content in the inverter. ( Nov/Dec 2016)
- 10.Explain the operation of single phase current source inverter with a neat sketch. State the merits and demerits of them.(May/June2016)
- 11.Briefly describe the different types of PWM schemes available for voltage control in inverter. (N/D2014) (May/June2014) (Nov/Dec2012) (Nov/dec2008)
- 12.Explain the working of series inverter with the aid of circuit diagram.(8) (May/June2014)
- 13.Explain about the current source inverter(8) (N/D2013) ( Nov/dec2008)

### UNIT-V AC TO AC CONVERTERS

1. What does ac voltage controller mean?

It is device which converts fixed alternating voltage into a variable voltage without change in frequency.

2. List out the applications of ac voltage controllers?(April/May 2018)(N/D2012)

- a. Domestic and industrial heating
- b. Lighting control
- c. Speed control of single phase and three phase ac motors
- d. Transformer tap changing

**3. What are the advantages of ac voltage controllers?**

- a. High efficiency
- b. Flexibility in control
- c. Less maintenance

**4. What are the disadvantages of ac voltage controllers?**

The main drawback is the introduction of harmonics in the supply current and the load voltage waveforms particularly at low output voltages

**5. What are the different control techniques for ac voltage controllers?**

- a. ON-OFF control
- b. Phase control

**6. What is the difference between ON-OFF control and phase control?**

ON-OFF control: In this method, the thyristors are employed as switches to connect the load circuit to the source for a few cycles of the load voltage and disconnect it for another few cycles. Phase control: In this method, thyristor switches connect the load to the ac source for a portion of each half cycle of input voltage.

**7. What is meant by unidirectional or half-wave ac voltage controller?**

Here the power flow is controlled only during the positive half-cycle of the input voltage.

**8. What are the disadvantages of unidirectional or half-wave ac voltage controller? (Nov/DEC2017)**

- a. Due to the presence of diode on the circuit, the control range is limited and the effective RMS output voltage can be varied between 70.7% and 100%.
- b. The input current and output voltage are asymmetrical and contain a dc component. If there is an input transformer, saturation problem will occur.
- c. It is only used for low power resistive load.

**9. What is meant by bidirectional or half-wave ac voltage controller?**

Here the power flow is controlled during both cycles of the input voltage.

**10. What is meant by cyclo-converter? (Nov/dec2016) (Nov/Dec2014)**

It converts input power at one frequency to output power at another frequency with one-stage conversion. Cycloconverter is also known as frequency changer.

**11. What are the two types of cyclo-converters?**

- a. Step-up cyclo-converters
- b. Step-down cyclo-converters

**12. What are the applications of cyclo-converter? (N/D2013)(N/D2011)**

- a. Induction heating
- b. Speed control of high power ac drives
- c. Static VAR generation
- d. Power supply in aircraft or ship boards

**13. What is meant by positive converter group in a cyclo converter?**

The part of the cycloconverter circuit that permits the flow of current during Positive half cycle of output current is called positive converter group.

**14. What is meant by negative converter group in a cyclo converter?**

The part of the cyclo converter circuit that permits the flow of current during negative half cycle of output current is called negative converter group.

**15. What is matrix converter? (April/MAY2017)(May/June2014)(N/D2013)**

It is capable of direct conversion from AC to AC by using bidirectional fully controlled switches.

**16. Mention the advantages of matrix converter over conventional converter. (April/MAY 2018)**

- i) Inherent bidirectional power flow.
- ii) sinusoidal input and output waveforms with moderate switching frequency.
- iii) Possibility of compact design due to absence of DC – link reactive components.
- iv) Controllable input power factor independent of the output load current

**17. Explain the term sequence control of AC Voltage regulators. (Nov/Dec 2017)**

It consists of two or more stages of voltage controller in parallel. It contains low harmonic content and high power factor.

**18. Compare integral cycle control and phase control in AC Voltage controller. (April/MAY 2017)**

integral cycle control	phase control
It consists of switches to connect the load circuit to the source for a few cycles of the source voltages and disconnect it for another few cycles.	It consists of only one stage AC voltage controller.
	More harmonic content and low power factor.

**19. Differentiate ON-OFF Control and Phase control in AC-AC Converters. (Nov/dec 2016)**

ON-OFF Control	Phase control
In this method the thyristors are employed as switches to connect the load circuit to the source for a few cycles of the source voltage and disconnect it for another few cycles.	In this method, the thyristor switches connect to the load to the ac source for a portion of each cycle of input voltage.

**20. What is integral cycle control? (May/June 2016) (Nov/Dec 2014) (N/D 2011)**

It consists of switches to connect the load circuit to the source for a few cycles of the source voltages and disconnect it for another few cycles.

**21. What is the control range of firing angle in ac voltage controller with R-L load? (May/June 2014)**

The conduction angle  $\gamma = \beta - \alpha$

The control range of firing angle in phase controlled AC Voltage controller is  $0 < \alpha < 180^\circ$

**22.) Write the principle of operation of cycloconverter. (N/D 2012)****PART-B**

1. Explain the operation of multistage control of AC voltage controllers with neat diagram. (A/M 2018) (16)
2. Explain the operation of 1 $\phi$  AC voltage controller with RL load. (16) (May/June 2016) (M/J 2015) (M/J 2014)
3. Explain the operation of 1 $\phi$  step-up cyclo converter with R load. (16)
4. Explain the operation of 1 $\phi$  step-down cyclo converter with R load. (16)

5. Explain the operation of Matrix converter. (16).(N/D2017)
6. Explain the operation of  $3\phi$  to  $1\Phi$  cyclo converter with relevant diagram. (16) (A/M2018)  
(N/D2017) (N/D2016)(Nov/dec2014)
- 7.Explain the operation of  $1\phi$  -  $1\phi$  step up cycloconverter with bridge configuration.(N/D2017)
8. Explain the operation of  $1\phi$  -  $1\phi$  step down cycloconverter for a bridge type converter.(N/D2013)
8. Explain the operation of two stages sequence control of AC voltage controller. (N/D2017)  
(N/D2016)(N/D2011)
9. Explain the operation of  $3\phi$  to  $1\Phi$  cyclo converter with continuous and discontinuous load current with circuit and waveforms.(M/J2015)(M/J2014)(N/D2012)(N/D2011)
- 10.Explain the matrix converter.(8)(Nov/dec2014)
- 11.Explain the power factor control in AC voltage controller.(8) (M/J2014)
12. Write a short note on (N/D2013)
  - i)Integral cycle control.
  - ii)Multistage sequence control
  - iii)step up cyclo converter
  - iv)Matrix converter

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