SRI VENKATESWARA
COLLEGE OF ENGINEERING AND TECHNOLOGY
Thirupachur-631203, Tiruvallur TK & DT
Approved by AICTE New Delhi & Affiliated to Anna University, Chennai
(A Telugu Minority Institution)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POWER ELECTRONICS

UNIT I POWER SEMI-CONDUCTOR DEVICES
PART-A

1. Define latching current.
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.

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

3. What are the advantages of MOSFET over BJT?
- Power MOSFET has lower switching losses.
- No secondary Breakdown
- Switching frequency is high
- MOSFET has a positive temperature coefficient for resistance.

4. What is reverse recovery time.
The reverse recovery time is defined as the time between the instant, forward diode current. Becomes zero and 25% of the maximum reverse current.

5. Why IGBT is very popular nowadays?
- Lower rate requirements
- Lower switching losses
- Smaller snubbed circuit requirements

6. What are the different methods to turn on the thyristor?
- Forward voltage triggering
- Gate triggering
- dv/dt triggering
- Temperature triggering
- Light triggering

7. IGBT is a voltage controlled device. Why?
Because the controlling parameter is gate-emitter voltage.

8. Power MOSFET is a voltage controlled device. Why?
Because the output (drain) current can be controlled by gate-source voltage.

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9. Power BJT is a current controlled device. Why?
Because the output (collector) current can be controlled by base current.

10. Why TRIAC is not popular as compared to SCR? Justify
Commutation of Triac in inductive load is difficult when compared to SCR. Hence it is not Popular.

11. What is a snubber circuit?
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.

14. What losses occur in a thyristor during working conditions?
a. Forward conduction losses
b. Loss due to leakage current during forward and reverse blocking.
c. Switching losses at turn-on and turn-off.
d. Gate triggering loss.

15. **Define circuit turn off time.**
It is defined as the time during which a reverse voltage is applied across the thyristor during its commutation process.

16. **Mention the advantages of "RC" triggering over "R" triggering**
Circuit turn off time should be greater than the thyristor turn-off time for reliable turnoff, otherwise the device may turn-on at an undesired instant, a process called commutation failure.

17. **What are the advantages of GTO over SCR?**
- GTO has faster switching speed
- Its surge current capability is comparable with an SCR.
- It has more di/dt rating at turn-on.
- GTO circuit configuration has lower size and weight as compare to SCR.

18. Why MOSFETs are not preferred for low Applications?
MOSFETs are majority carrier devices. At low frequencies the internal losses are very high, hence MOSFETs are not preferred for low frequency.

19. How is di/dt and dv/dt protection provided in SCR
The snubber Circuit is a series combination of resistor 'R' and capacitor 'C'. They are connected across the thyristor to be protected. The capacitor 'C' is used to limit the dv/dt across the SCR. The resistor 'R' is used to limit high discharging current through the SCR.

20. What is commutation? Mention its types.
Commutation is defined as the process of turning off a thyristor.
1. Natural commutation 2.
Forced commutation.

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PART B & C

1. Explain the switching characteristics of IGBT & MOSFET
2. Explain why TRIAC is rarely used in 1st quadrant with negative pulse and positive pulse in 3rd quadrant?
3. With neat sketch explain the turn on and turn off characteristic of SCR.
4. Discuss steady state and the switching characteristics of power MOSFET.
5. Explain the operation of IGBT with the help of neat structural diagram & suitable waveforms.

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6. Explain the design procedure of Snubber circuits
7. Describe the UJT triggering circuit with neat sketch
8. Discuss any two types of commutation circuits used for SCR in detail .
9. Explain various types of commutation circuits for SCR.
10. Explain the structure, different modes of operation and characteristics of Triac.

UNIT II PHASE-CONTROLLED CONVERTERS
PART-A

1. 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 thyristors is fired.

2 Classify the different types of Controlled Rectifier.
Majorly these are classified into two types they are single phase and three phase rectifier. Further rectifiers are classified into three types namely uncontrolled, half controlled and full controlled rectifiers.

3. What is Dual Converter?
When polarities of output voltage as well as current can be reversed, then it is called dual converter.

4. What is the function of freewheeling diodes in controlled rectifier?
□□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.

5. What are the advantages of freewheeling diodes in a controlled rectifier? Input power factor □□is improved.
□□Load current waveform is improved and thus the load performance is better.

6. Define Input power factor.
In AC circuits, the power factor is the ratio of the real power that is used to do work and the apparent power that is supplied to the circuit. The power factor can get values in the range from 0 to 1. When all the power is reactive power with no realpower (usually inductive load) - the power factor is 0.

7. What is commutation angle or overlap angle?
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.

8. Distinguish between symmetrical and Asymmetrical semiconductor Configuration
Waveforms of supply current Is and output voltage Vo are same for both configurations. Hence, supply RMS current and average output voltage are also same for both configurations. However, the difference arises in the waveforms of diode current ID and thyristor current IT for the two configurations.
Operation-wise: In Symmetrical Configuration the freewheeling path is through a (thyristor-diode) combination and in asymmetrical configuration is through a (diodediode) combination.

9. What are the advantages of six pulse converter?
□□Commutation is made simple.
□□
□□

Distortion on the AC side is reduced due to the reduction in lower order harmonics. Inductance reduced in series is considerably reduced.

10. What is the effect of inductive load in the performance of three phase bridge rectifier?
Power factor reduces because of inductive load. Output
current ripple reduces due to inductive load Output
current tends to become continuous.

11. Define Distortion factor
Distortion factor is defined as the ratio of fundamental component to the total RMS value.

12. Why is the power factor of semiconductor better than full converter? Usage of freewheeling diode in the semi converter increases the power factor of the converter over the full converter.

13. What are the effects of source impedance in the controlled rectifier? The average output
□□voltage should be reduced
□□Reduced displacement factor
□□Output current waveform also changed.

14. Define Voltage ripple factor
Voltage ripple factor is defined as the ratio of the net harmonic content of the output voltage to the average output voltage.

15. What are the advantages of 3 phase controlled rectifier? o Output voltage increases o Ripple content decreases o By using higher number of pulses, output voltage should be smoother.

16. List out the application of light dimmer?
Applications for Light Dimmer Switches.
An effective way to quickly change the mood of a room is by dimming or brightening the lights with a dimmer switch.
A softer light results in a more comforting, relaxing atmosphere. Brighter lighting is more suitable for normal room use and reading.

17. List various applications of phase controlled converters
1. Dc motor drives
2. Battery charges
3. UPS system
4. HVDC transmission
5. Dc traction system

18. **What is meant by Natural & Forced commutation?**
Natural Commutation: Here the current flowing through the thyristor goes through a natural zero and enable the thyristor to turn off.
Forced commutation: The current flowing through the thyristor is forced to become zero by external circuitry

20. Give the application of fly wheel diode in a full converter
1. Relay drivers
2. H-bridge motor drivers 3. Full wave rectifier

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PART B & C

1. Discuss the operation of single phase half controlled rectifier with inductive load. Also derive the average output voltage equation.
2. Explain single phase half wave rectifier circuit with RL load and freewheeling diode.
3. Explain the principle of single Phase full bridge converter with RL (or) RLE load.
4. Explain the operating principle of single phase dual converter with necessary waveforms.
5. Explain the operating principle of three phase dual converter with necessary waveforms
6. Explain the effect of source inductance in the operation of 1 □□ fully controlled converter 7. Explain the operating of three phase fully controlled rectifier supplying R load with neat waveforms and also derive an expression for average output voltage
8. With necessary circuit and waveforms, explain the principle of operation of 6 – pulse converter (fully controlled). Derive the expression for average output voltage in it.
9. Write shrt note on (i) Light dimmer (ii) Solar PV system
10. A single phase semi converter is operated from 120V, 50 Hz ac supply. The load current with an average value Idc is continuous and ripple factor firing angle $\alpha = \pi/6$. Determine (i) Displacement factor, (ii) Harmonic factor of input current (iii) Input power factor.
11. A single phase full bridge converter is connected to „R" load. The source voltage is of 230V, 50 Hz. The average load current is of 10A. For R = 20Ω find the firing angle.
12. Explain the operation of a single phase full bridge converter with RL load for continuous and discontinuous load currents.

13. A 220 V, 1 kW resistive load is supplied by 220 V, 50 Hz source through single phase fully controlled rectifier. Determine the following for 800 W output. (i) output voltage, (ii) rms value of input current, (iii) fundamental component of input current & (iv) displacement factor. **14.** A single phase full converter is supplied from 230V, 50 Hz source. The load consists of R = 10 Ω and a large inductance so as to render the load current constant. For a firing angle of 30 degree, determine (i) average output voltage (ii) average output current (iii) average and rms values of thyristor currents (iv) the power factor. Also if the source has an inductance of 1.5 mH, determine (1) average output voltage, (2) the angle overlap (3) the power factor.

15. A highly inductive load, such that load current can be assumed constant, is to be supplied from a 230V, 50 Hz, single phase supply by a fully controlled and a half controlled bridges. Compare the average load voltage provided by each bridge at a firing angle of 30

16. A single phase bridge converter is utilized to produce regulated DC output voltage. The input voltage is 230 V and the load current is 8A for a firing angle of 30 (i) Calculate the dc output voltage (ii) Calculate the dc output voltage and current if a freewheeling diode is used at the output for the same firing angle (30□).

UNIT III DC TO DC CONVERTERS
PART-A

1. What is meant by dc chopper?

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

2. 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.

3. What is meant by duty-cycle?

Duty cycle is defined as the ratio of the on time of the chopper to the total time period of the chopper.

4. What are the applications of dc chopper?

a. Battery operated vehicles
b. Traction motor control in electric traction
c. Trolley cars
d. Marine hoists
e. Mine haulers
f. Electric braking.

5. What are the two types of control strategies?

a. Time Ratio Control (TRC)
b. Current Limit Control method (CLC)

6. What is meant by TRC? Mention its types

In TRC, the value of **Ton / T** is varied in order to change the average output voltage.

Types:

a. Constant frequency control
b. Variable frequency control.

7. What is meant by CLC?

Current Limit Control: In this control strategy, the ON and OFF of chopper circuit is decided by the previous set value of load current. The two set values are maximum load current and minimum load current. When the load current reaches the upper limit, chopper is switched off.

8. What is meant by PWM control in dc chopper?

In this control method, the on time Ton 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).

9. Write down the expression for the average output voltage for step down & step up chopper.

Average output voltage for step down chopper is VO = α. VS for step up chopper is VO = VS x [1/ (1−α)]. Where α=Duty cycle, Vs=Supply voltage

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

a. Voltage commutated chopper.
b. Current commutated chopper.
c. Load commutated chopper.

11. What is battery operated Vehicle

Battery electric vehicles, or BEVs, use electricity stored in a battery pack to power an electric motor and turn the wheels. Not using gasoline or diesel also means that battery electric cars are significantly cheaper to fuel than conventional vehicles.

12. What are the main parts in chopper firing circuits o Triangular wave Generator o Voltage comparator o Edge detector o Pulse Amplifier

13. What is resonant converter?

Resonant converter is a type of electric power converter that contains a network of inductors and capacitors called a "resonant tank", tuned to resonate at a specific frequency. They find applications in electronics, in integrated circuits.

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

15. How output frequency is varied in case of a thyristor?
The output frequency is varied by varying the turn off time of the thyristors in the inverter circuit, i.e. the delay angle of the thyristors is varied.

16. What is meant by SMPS?
SMPS is based on a DC chopper with a rectified and possibly transformed output. The output voltage amplitude is controlled by duty ratio of the chopper.

18. What is meant by zero current switching of resonant converter?
The switches of resonant converter are turn on and turn off at zero current. This converter is called zero current switching of resonant converter.

19.What is meant by FM control in a Dc Chopper
In frequency modulation control, the chopping frequency is varied. Here 2 controls are possible
1. ON time Ton kept constant
2. OFF period TOFF is kept constant

20. What are the Disadvantages of FM Control?
The chopping frequency has to be varied over a wide range for the control of output. It generates harmonics at unpredictable frequencies.

PART-B & C

1. Discuss the principle of operation of DC – DC step down and step up chopper with suitable waveforms. Derive an expression for its average DC output voltage.
2. Classify the basic topologies of switching regulators and explain the operation of buck regulators with continuous load current using suitable waveforms
3. Describe working principle of boost converter with necessary circuit & waveforms
4. Explain the working of Buck – Boost converter with sketch and waveforms and also derive the expression for Is
5. Discuss the operation of the resonant switching based SMPS
6. With a neat sketch & waveforms, explain the working of full bridge SMPS
7. Write short notes on Resonant Switching
8. Briefly explain about Battery operated Vehicle
9. Discuss the operation of the resonant converter
10. A dc chopper has an input voltage of 200V and a load of 20 ohms resistance. When chopper is ON, its voltage drop is 1.5V and the chopping frequency is 10 KHz. If the duty cycle is 80%, find (i) Average output voltage, (ii) RMS output voltage and (iii) chopper ON time.
11. A step – down dc chopper has a resistive load of R = 15 Ω and input voltage Edc = 200V. When the chopper remains ON, its voltage drop is 2.5 for a duty cycle of 0.5. Calculate (i) Average and rms value of output voltage (ii) Power delivered to the load.
12. A type A chopper has supply voltage Vs and duty cycle of (A) 0.4 and (B) 0.6 For these duty cycles, calculate (1) average & rms values of output voltage (2) output power for R load (3)ripple factor
13. step up chopper has input voltage of 220V and output voltage of 660V. If the non conducting time of thyristor chopper is 100 μsec compute the pulse width of output voltage. Incase the pulse width is halved for constant frequency operation. Find the new output voltage. Derive the expressions used in the above problem with necessary waveform.

14. A voltage commutated chopper circuit provides the speed control of DC separately excited motor. The sources voltage is 80 V. The starting current is 60 A & thyristors turn – off time is 20 s. Calculate the values of commutating capacitor & inductor if chopping period is 2000 s

UNIT IV INVERTERS
PART-A

1. Why diodes should be connected in anti parallel with the thyristors in inverter circuits? For RL loads, load current will not be in phase with load voltage and the diodes connected in anti parallel will allow the current to flow when the main thyristors are turned off. These diodes are called feedback diodes.

2. What is meant a series inverter?
An inverter in which the commutating elements are connected in series with the load is called a series inverter.

3. What are the advantages of CSI?
- CSI Does not required any feedback diodes.
- Commutation circuit is simple as it contains only capacitors.

4. What is the condition to be satisfied in the selection of L and C in a series inverter? $R2 < 4L$

5. What is meant a parallel inverter?
An inverter in which the commutating elements are connected in parallel with the load is called a parallel inverter.

6. What are the applications of a series inverter?
(i) Ultrasonic generator. (iii) Sonar Transmitter
(ii) Induction heating. (iv) Fluorescent lighting

7. 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.

8. What is the purpose (or) function of feedback diodes in Inverters?
The diodes provide the path for the flow of reactive power

9. What are the applications of a CSI?
a. Induction heating
b. Lagging VAR compensation
c. Speed control of AC motors
d. Synchronous motor starting.

10. 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

11. What are the advantages of PWM control?
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The output voltage can be obtained without any additional components.

Lower order harmonics can be eliminated or minimized along with its output voltage control. As the higher order harmonics can be filtered easily, the filtering requirements are minimized.

12. List out the advantage of multiple PWM over single PWM technique.

(i) Distortion factor is reduced (ii) Power factor improved

13. What are the methods of reduction of harmonic content?

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

15. What are the disadvantages of PWM control?

SCRs are expensive as they must possess low turn-on and turn-off times.

16. What does ac voltage controller mean?

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

17. What are the applications of ac voltage controllers?

(i) Domestic and industrial heating (ii)Transformer tap changing
(iii)Lighting control (iv) Speed control of single phase and three phase ac motors

18. What are the advantages of ac voltage controllers?

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

19. 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.

20.What are the two methods of control in ac voltage controllers?

a. ON-OFF control
b. Phase control

21. List four application of CSI

□□Induction Heating
□□Speed control of AC motors
□□Synchronous motor starting
□□Lagging VAR compensation.

22. Give the use of resonant switching in power electronic circuits

Resonant Switch Converters. In ZVS and ZCS **switching** topologies typically **use Resonance** techniques to force the voltage or current in a semiconductor **switch** to zero, resulting to the elimination or reduction of the **switching** losses.

23. What are the applications of an inverter?

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

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e. HVDC transmission

24. List out the application of Induction heating ?
Applications including surface hardening, melting, brazing and soldering.

25. Define UPS
A device that provides battery backup when the electrical power fails or drops to an unacceptable voltage level is called UPS (Uninterruptible Power Supply)

PART B & C

1. Discuss in detail about the functioning of three phase voltage source inverter in 120 operating mode
2. With a neat sketch and output voltage waveforms, explain the working of three phase bridge inverter in 180 degree mode of operation
3. Describe the working of single phase full bridge inverter, for different types of loads (i) R, (ii) RL, (iii) RLC draw load voltage and load current waveforms.
4. What PWM? List the various PWM techniques and explain any one of them
5. Describe the operation of single phase auto sequential commutated current source inverter with power circuit and waveforms
6. Explain the operation of 3 phase auto sequential commutated current source inverter with power circuit and waveforms
7. Explain the working principle of current source inverter.
8. Write short note on Space vector modulation.
9. Explain the operation of series resonant Inverter
10. Describe the operation of single phase AC voltage source inverter and obtain its relevant equations.
11. Write short note on (i) Induction heating (ii) UPS

UNIT V AC TO AC CONVERTERS
PART A

1. What is meant by AC voltage controller?
AC Voltage controller converter fixed AC voltage into a variable AC output voltage without change in supply Frequency.

2. List out the application of AC voltage controller?
- Domestic and industrial heating
- Lighting control
- Speed control
- Transformer tap changing.

3. 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.

4. What is the advantage of ON-OFF control?

Due to zero-voltage and zero current switching of thyristors, the harmonics generated by the switching action are reduced.

5. What is the disadvantage of ON-OFF control?
This type of control is applicable in systems that have high mechanical inertia and high thermal time constant.

6. What are the different control techniques for AC regulators
- Phase Control Method
- Integral cycle switching

7. Mention merits and demerits of AC voltage controllers
Merits
1. They use line commutation; hence no extra commutation circuits are required
2. They have high efficiencies, since device losses are reduced.

Demerits
Large ripple and harmonics are present in the output Output waveforms are not sinusoidal.

8. What are the disadvantages of unidirectional or half-wave ac voltage controller?
- 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%.
- The input current and output voltage are asymmetrical and contain a dc component. If there is an input transformer, saturation problem will occur It is only used for low power resistive load.

9. What is meant by Integral cycle control?
Integral cycle controllers are converters with the ability to perform direct switching without losses. The process directly converts AC to AC without having to perform the intermediate processes of AC to DC then DC to AC. The basic integral control cycle is sinusoidal in nature.

10. What are the firing pulse requirements of a thyristor in an AC voltage controller?
For R Load: Single pulse is enough to turn ON the thyristor
For RL Load: Continuous gate signal is applied to turn ON the thyristor

11. What type of gating signal is used in single phase ac voltage controller with RL load? High frequency carrier gating signal is used for single phase ac voltage controller with RL load.

12. What are the disadvantages of continuous gating signal?
a. More heating of the SCR gate.
b. Increases the size of pulse transformer.

13. What is meant by high frequency carrier gating?
Thyristor is turned on by using a train of pulses from α to π. This type of signal is called as high frequency carrier gating.

14. What is meant by sequence control of ac voltage regulators?
It means that the stages of voltage controllers in parallel triggered in a proper sequence one after the other so as to obtain a variable output with low harmonic content.

15. What are the advantages of sequence control of ac voltage regulators?
a. System power factor is improved.
b. Harmonics are reduced in the source current and the load voltage.

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16. What is meant by cyclo-converter?
It converts input power at one frequency to output power at another frequency with onestage conversion. Cyclo converter is also known as frequency changer.

17. What are the two types of cyclo-converters?
a. Step-up cyclo-converters
b. Step-down cyclo-converters

18. What is meant by step-up cyclo-converters?
In these converters, the output frequency is less than the supply frequency.

19. What is meant by step-down cyclo-converters?
In these converters, the output frequency is more than the supply frequency.

20. What are the applications of cyclo-converter?
a. Induction heating
b. Speed control of high power ac drives
c. Static VAR generation
d. Power supply in aircraft or ship boards

21. What is Matrix Converter?
Matrix converter is a capable of direct conversion from AC to AC by using bidirectional fully controlled switches.

22. List out the Advantages of Matrix Converter over conventional converter.
□□Inherent bidirectional power flow.
□□Possibility of compact design
□□Sinusoidal input and output waveforms with moderate switching frequency. Controllable
□□input power factor independent of the output load current.

23. What are the different types of welding?
The main **Types of welding** used in industry and by home engineers are commonly referred as
□□Mig **welding**,
□□Arc **welding**,
□□Gas **welding** and
□□Tig **welding**

PART B & C

1. Explain the operation of single phase to single phase cycloconverter (step up/step down)
2. Discuss the working of a 3 phase to single phase cyclo-converter with neat voltage and current waveforms
3. Describe 3□□ to 3 □□cycloconverter with relevant circuit arrangement using 18 SCRs
4. Describe the operation of single phase full wave ac voltage controller with the help of voltage and current waveform. Also derive the expression for average value of output voltage **5.** Explain the principle of integral cycle control.
6. A single phase voltage controller has input voltage of 230V, 50 Hz and a load of R = 15Ω. For 6 cycles ON and 4 cycles OFF, determine. (1) rms output voltage (2) input pf and (3) average and rms thyristor currents.
7. Describe the working principle of single phase ac voltage controller with circuit and waveforms.
8. Discuss the working of 2 stage sequence control of AC voltage controller
9. Explain the working of multistage sequential control of AC voltage controller

10. What is mean by Welding? briefly explain
11. For a 1□□ Ac voltage controller feeding a resistive load, draw the waveforms of source voltage gating signals, output voltage, source and output current. Describe its working with reference to waveforms drawn.
12. Draw the possible configurations of a 1 □AC voltage controller and compare them.
13. Discuss the working of a 1 □□ ac voltage controller with RL load when it firing angle is more than the load power factor angle. Illustrate with waveforms.
14. Obtain the expression for power factor for a 1 □ac voltage regulator with R load.
15. A resistive load of 5Ω is fed through a single phase full wave AC voltage controller from 230 V, 50 Hz source. If firing angle of thyristors is 120□find the output RMS voltage, input power factor and average current of thyristor.
16. A single phase full wave AC voltage controller has an input voltage of 230V, 50Hz and it is feeding a resistive load of 10 ohms. If firing angle of thyristors is 110 , find the output RMS voltage, input power factor and average current of thyristors.

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