

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**QUESTION BANK**

**EE 6503 POWER ELECTRONICS**

**III<sup>rd</sup> / V<sup>th</sup> SEM**

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

**PART A**

- 1. Why IGBT is very popular nowadays?**
- 2. What are the different methods to turn on the thyristor?**
- 3. What is the difference between power diode and signal diode?**
- 4. IGBT is a voltage controlled device. Why?**
- 5. Power MOSFET is a voltage controlled device. Why?**
- 6. Power BJT is a current controlled device. Why?**
- 7. What are the different types of power MOSFET?**
- 8. How can a thyristor turned off?**
- 9. Define latching current**
- 10. Define holding current.**
- 11. What is a snubber circuit?**
- 12. What losses occur in a thyristor during working conditions?**
- 13. Define hard-driving or over-driving.**
- 14. Define circuit turn off time.**
- 15. Why circuit turn off time should be greater than the thyristor turn-off time?**
- 17. What is the turn-off time for converter grade SCRs and inverter grade SCRs?**
- 18. What are the advantages of GTO over SCR?**
- 19. What is meant by phase controlled rectifier?**
- 20. Mention some of the applications of controlled rectifier.**

**PART- B**

- 1. Explain the structure and operation of turn on and turn off characteristics of SCR**

2. (i) Describe the any two methods of turn-on mechanism of SCR.  
(ii) Explain the turn off characteristics of SCR.
3. Discuss the transfer, output and switching characteristics of IGBT.
4. Explain the switching performance of BJT with relevant waveforms indicating clearly the turn on, turn off times and their components.
5. (i) Draw and explain the forward characteristics of SCR using two transistor model of SCR.  
(ii) Compare any six salient features of MOSFET with IGBT.
6. (i) Compare the performance characteristics of MOSFET with BJT.  
(ii) Briefly discuss the R-C triggering of SCR.
7. Discuss the operation of power MOSFET and explain the transfer, output and switching characteristics of power MOSFET.
8. Differentiate natural commutation and forced commutation.
9. Explain the operation of driver and snubber circuits for power MOSFET.
10. Explain with diagram the various modes of working of TRIAC

## **UNIT-II PHASE-CONTROLLED CONVERTERS**

### **PART A**

- 1. What is the function of freewheeling diodes in controlled rectifier?**
- 2. What are the advantages of freewheeling diodes in a controlled in a controlled rectifier?**
- 3. What is meant by delay angle?**
- 4. What are the advantages of single phase bridge converter over single phase mid-point converter?**
- 5. What is commutation angle or overlap angle?**
- 6. What are the different methods of firing circuits for line commutated converter?**
- 7. Give an expression for average voltage of single phase semiconverters.**
- 8. What is meant by input power factor in controlled rectifier?**
- 9. What are the advantages of six pulse converter?**
- 10. What is meant by commutation?**

11. What are the types of commutation?
12. What is meant by natural commutation?
13. What is meant by forced commutation?
14. What is meant by dc chopper?
15. What are the applications of dc chopper?
16. What are the applications of dc chopper?
17. What is meant by step-up and step-down chopper?
18. Write down the expression for average output voltage for step down chopper.
19. Write down the expression for average output voltage for step up chopper.
20. What is meant by duty-cycle?

#### PART-B

1. Explain the operation of three phase half wave controlled converter with inductive load. Sketch the associated waveforms. (16)
2. With necessary circuit and waveforms, explain the principle of operation of three phase controlled bridge rectifier feeding R-L load and derive the expression for the average output dc voltage. (16)
3. Explain the operation of three phase semi converter with RLE load. Sketch the associated waveforms. (16)
4. i) Explain the effect of source inductance in the operation of single phase fully controlled converter, indicating clearly the conduction of various thyristors during one cycle. (8)  
 ii) Explain the working of single phase dual converter with circuit diagram and waveforms. (8)
5. Explain the effect of source inductance in the operation of three phase fully controlled converter, indicating clearly the conduction of various thyristors during one cycle with relevant waveforms. (16)
6. i) Derive an expression for harmonic factor, displacement factor and power factor of a single phase semiconverter from the fundamental principle. (8)
7. ii) Three phase fully controlled rectifier is connected to three phase ac supply of 230V, 60 Hz. load current is continuous and has a negligible ripple. If the average load current  $I_{dc} = 150$  A and the commutating inductance  $L_c = 0.1$  mH. Determine the overlap angle when  $\alpha = 10^\circ$ . (8)
8. A three phase half wave rectifier is operated from three phase star connected 208V, 60Hz supply. Load resistance = 10 Ohm. If it is required to obtain an average output voltage 50 % of max possible output voltage. Calculate i) delay angle ii) rms value of output current iii) average value of output current iv) thyristor avg and rms current v)

9. Explain the operation of single phase dual converter with circulating and non circulating current type. (16)
10. Explain the operation of three phase dual converter with circulating and non circulating current type. (16)

### **UNIT-III**

#### **DC TO DC CONVERTER**

##### **PART A**

1. What are the two types of control strategies?
2. What is meant by TRC?
3. What are the two types of TRC?
4. What is meant by FM control in a dc chopper?
5. What is meant by PWM control in dc chopper?
6. Write down the expression for the average output voltage for step down and step up chopper.
7. What are the different types of chopper with respect to commutation process?
8. What is meant by voltage commutation?
9. What is meant by current commutation?
10. What is meant by load commutation?
11. What are the advantages of current commutated chopper?
12. What are the advantages of load commutated chopper?
13. What are the disadvantages of load commutated chopper?
14. What is meant by inverter?
15. What are the applications of an inverter?
16. What are the main classification of inverter?
17. Why thyristors are not preferred for inverters?
18. How output frequency is varied in case of a thyristor?
19. Give two advantages of CSI.

## PART – B

1. Draw the circuit diagram of buck regulator and explain its working principle with necessary waveforms. Derive the expression for peak to peak ripple voltage of the capacitor that is present across the load. (16)
2. Describe the working principle of boost converter with necessary circuit and waveforms. (16)
3. i) Explain the various control strategies of chopper (10)  
ii) Design a filter component of a buck converter which has an input voltage of 12 V and output voltage of 5V. The peak to peak output ripple voltage is 20mV and peak to peak ripple current of inductor is limited to 0.8A. The switching frequency is 25KHz. (6)
4. i) A dc chopper has an input voltage of 200V and a load of 15ohm resistance. When the chopper is on, its voltage drop is 1.5V and the chopping frequency is 10KHz. If the duty cycle is 80%. Find  
i) average and rms output voltage ii) chopper on time. (12)  
ii) prove the output voltage of step down chopper is  $V_o = D V_s$ . (4)
5. Describe the working principle of buck-boost converter with necessary circuit and waveforms. (16)
6. What is SMPS? Mention the types of SMPS. Explain flyback SMPS in detail. (16)
7. Write short notes on Push pull SMPS, half bridge and full bridge SMPS (16)
8. Explain L type zero current switching resonant converters. (16)
9. Explain M type zero current switching resonant converters. (16)
10. Explain zero voltage switching resonant converters. (16)

## UNIT-IV

### INVERTERS

#### PART A

1. Why diodes should be connected in antiparallel with the thyristors in inverter circuits?
2. What types of inverters require feedback diodes?
3. What is meant a series inverter?
4. What is the condition to be satisfied in the selection of L and C in a series inverter?
5. What is meant a parallel inverter?

6. What are the applications of a series inverter?
7. How is the inverter circuit classified based on commutation circuitry?
8. What is meant by McMurray inverter?
9. What are the applications of a CSI?
10. What is meant by PWM control?
11. What are the advantages of PWM control?
12. What are the disadvantages of the harmonics present in the inverter system?
13. What are the methods of reduction of harmonic content?
14. Compare CSI and VSI.
15. What are the disadvantages of PWM control?
16. What does ac voltage controller mean?
17. What are the applications of ac voltage controllers?
18. What are the advantages of ac voltage controllers?
19. What are the disadvantages of ac voltage controllers?
20. What are the two methods of control in ac voltage controllers?

#### **PART – B**

1. Explain the principle of operation of 3 phase voltage source inverter with 180° conduction mode with necessary waveforms and circuits. Also obtain the expression for line to line voltage.
2. Discuss the functioning of three phase voltage source inverter in 120 degree operating mode with relevant waveforms and obtain the expression for voltages.
3. Explain the following PWM techniques used in inverter.
  - i) Sinusoidal PWM
  - ii) Multiple PWM.
4. Explain the operation of single phase capacitor commutated CSI with R load.
5. Explain the harmonic reduction by transformer corner lines and stepped wave inverters.
6. Explain the different methods of voltage control adopted in an inverter with suitable waveforms.
7. Explain the working of series inverter with the help of circuit diagram and relevant waveforms.
8. Draw the circuit diagram of current source inverter and explain its operation with relevant waveforms.

9. Describe the working of a single phase full bridge inverter supplying R, RL loads with relevant circuit and waveforms.
10. What is the need for controlling the output voltage of inverters? Classify the various techniques adopted to vary the inverter gain and brief on sinusoidal PWM.

## **UNIT-V**

### **AC TO AC CONVERTERS**

#### **PART A**

1. What is the difference between ON-OFF control and phase control?
2. What is the advantage of ON-OFF control?
3. What is the disadvantage of ON-OFF control?
4. What is the duty cycle in ON-OFF control method?
5. What is meant by unidirectional or half-wave ac voltage controller?
6. What are the disadvantages of unidirectional or half-wave ac voltage controller?
7. What is meant by bidirectional or half-wave ac voltage controller?
8. What is the control range of firing angle in ac voltage controller with RL load?
9. What type of gating signal is used in single phase ac voltage controller with RL load?
10. What are the disadvantages of continuous gating signal?
11. What is meant by high frequency carrier gating?
12. What is meant by sequence control of ac voltage regulators?
13. What are the advantages of sequence control of ac voltage regulators?
14. What is meant by cyclo-converter?
15. What are the two types of cyclo-converters?
16. What is meant by step-up cyclo-converters?
17. What is meant by step-down cyclo-converters?
18. What are the applications of cyclo-converter?
19. What is meant by positive converter group in a cyclo converter?
20. What is meant by negative converter group in a cyclo converter?

## PART-B

1. Draw the circuit diagram of three phase to single phase cycloconverter and explain its operation with waveforms
2. With the necessary circuit diagram and waveforms, explain the principle of operation of single phase ac voltage controller having only thyristor feeding resistive load by on-off control and phase control. Derive the expression for rms value of output voltages in both cases.
3. 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.
4. Explain sinusoidal and multiple PWM techniques used in inverter.
5. Explain the operation of the step down cycloconverter both bridge and midpoint configuration with necessary waveforms.
6. With aid of circuit diagram, explain the operation of three phase to three phase cycloconverter employing three phase half wave circuits and list few of its applications.
7. Explain the operation of single phase half wave phase controller and single phase full wave phase controller with circuit diagrams and waveforms.
8. Explain the principle of working of single phase to single phase step up cycloconverter. List the factors that affect the performance of cycloconverters.
9. Discuss the working of a single phase AC voltage controller with RL load when its firing angle is more than the load power factor angle. Illustrate with waveforms.
10. A single phase voltage controller feeds power to a resistive load of  $3\Omega$  from 230V, 50 Hz source. Calculate 1) The maximum values of average and RMS thyristor currents for any firing angle  $\alpha$ . 2) The minimum circuit turn off time for any firing angle  $\alpha$ . 3) the ratio of third harmonic voltage to fundamental voltage for  $\alpha=60^\circ$