EE2301 POWER ELECTRONICS

UNIT-I

POWER SEMI-CONDUCTOR DEVICES

PART-A

1. Draw the V-I characteristics of SCR and mark the holding current and latching current in the characteristics.
2. What are the advantages of GTO over BJT?
3. Define: holding current and latching current of SCR
4. Define: string efficiency of SCRs connected in series
5. IGBT is a voltage controlled device. Why
6. Distinguish between holding current and latching current of SCR.
7. Why is pulse triggering preferred over RC triggering?
8. What is reverse recovery time?
9. Mention any two advantages of advantages of GTO over SCR
10. Why MOSFETs are not preferred for low frequency applications?
11. Why are IGBT becoming popular in their application to controlled converters?
12. What are the factors that influence the turn-off time of a thyristor?
13. Draw the turn on characteristics of SCR and mark the timings td ,tr and ton.
14. In TRIAC which of the modes the sensitivity of gate is high.
15. Define the term pinch off voltage of MOSFET
16. What are the advantages of MOSFET with BJT?
17. Power MOSFET is a voltage controlled device. Why?
18. Power BJT is a current controlled device. Why?
19. What is a snubber circuit?
20. Define hard-driving or over-driving.

PART B

1. Explain the structure and operation of turn on and turn of 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 IGBT4. 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 two pulse converters?

2. What is full converter? Mention its uses.

3. What is a delay angle of converters?

4. What is the principle of phase control half wave rectifier?

5. What is the function of freewheeling diode in Semi converter?

6. Draw the three phase half wave converter.

7. Write the expression for 3Φ full converter with RL load.

8. What is meant by full controlled rectifier?

9. Define: firing angle α

10. List the merits of phase control.

11. Why the power factor of semiconverter better than full Converter?

12. What is the inversion mode of rectifiers?

13. Define the terms: displacement factor, total harmonic distortion.

14. Under what conditions a single phase fully controlled converter gets operated as an inverter.

15. State the principle of phase control in AC-DC converter

16. It is required to operate a single phase full converter in the inverter mode with RLE load. Should the average output voltage be more or less than E during inverter operation? Why?

17. List various applications of phase controlled converters.

18. What is freewheeling diode and what is the purpose?

19. Define displacement factor.

20. Is the input power factor of fully controlled converter is less than that of half controlled converter? Justify your answer

PART B

1. Discuss the operation of single phase half controlled rectifier with R load. Also derive the average output voltage equation.

2. Explain the operation of three phase half controlled rectifier supplying R load with neat sketch. Also derive an expression for the average output voltage.

3. With necessary circuit and waveforms, explain the principle of operation of three phase fully controlled bridge rectifier feeding R-L load and drive the expression for the average output voltage.

4. With necessary circuit and waveforms, explain the principle of operation of single phase ac voltage controller feeding R load by on-off control and phase control. Derive the expression for rms value of output voltage in both cases.

5. For the single phase fully controlled bridge is connected to RLE load. The source voltage is 230 V, 50 Hz. The average load current of 10A continuous over the working range. For R= 0.4 Ω and L = 2mH, Compute
(a) firing angle for E = 120V
(b) firing angle for E = -120V

6. For a single phase Ac voltage controller feeding a R load draw the waveforms of source voltage, output voltage, source and output current. Describe its working with reference to waveforms drawn.

7. i) Describe the operation of single phase two pulse bridge converter using 4 SCRs with relevant waveforms. ii) Discuss the working of the above converter mode with RLE load.

8. i) A single phase two pulse converter feeds power to RLE load with R= 6Ω, L= 6mH, E= 60V, AC source voltage is 230V, 50Hz for continuous condition. Find the average value of load current for a firing angle of 50^{o}. In case one of the 4 SCRs gets open circuited. Find the new value of average load current assuming the output current as continuous. ii) Draw the possible configurations of a single phase AC voltage controller and compare them.

9. Discuss with the aid of schematic diagram and waveforms, the principle of operation of a two quadrant two pulse converter in the rectifying and inverting mode of operation.

10. Draw the circuit diagram and explain the operation of three pulse half controlled rectifier.

11. Draw the power circuit diagram of a 6 pulse two quadrant converter circuit. Explain the operation of the circuit with necessary wave forms.

UNIT-III

DC TO DC CONVERTER

PART- A

1. What are the control strategies of chopper?

2. Mention the disadvantages of FM scheme used in chopper

3. What are the methods of controlling the output voltage of a chopper?

4. What are the advantages and disadvantages of buck-boost regulator?

5. Define: duty cycle of dc chopper

6. Differentiate between constant frequency and variable frequency control strategies of varying the duty cycle of DC choppers.

7. What is meant by time ratio control in dc-dc converter?

8. What are the classification of dc to dc converter depending upon the directions of current and voltage?

9. What is meant by buck regulator?

10. What is meant by pulse width modulation control in dc chopper?

11. What is DC chopper?

12. What is two quadrant DC chopper?

13. What is time ratio control in chopper?

14. Write down the expression for the average output voltage for step down and step up chopper.

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

16. What is meant by voltage commutation?

17. What is meant by current commutation?

18. What is meant by load commutation?

19. What are the advantages of current commutated chopper?

20. What are the advantages of load commutated chopper?

PART B

1. i) Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage and duty cycle. State the assumptions made.
ii) A step-up chopper supplies a load of 480 V from 230 V dc supply. Assuming the non conduction period of the thyristor to be 50 microsecond, find the on time of the thyristor.

2. For a type A chopper (first quadrant), express the following variable as a function of VS, R and duty cycle δ in case the load is resistive.

3. Explain the operation of the step-up chopper and drive an expression for its output voltage

4. With the help of power circuit diagrams, discuss the operation of class-C and class- D choppers

5. In a type A chopper, the input supply voltage is 230 V the load resistance is 10Ω and there is a voltage drop of 2 V across the chopper thyristor when it is on. For a duty ratio of 0.4, calculate the average and r.m.s values of the output voltage. Also find the chopper efficiency.

6. i) Draw the circuit diagram of a buck converter and explain its operation with equivalent circuit for different modes and waveforms.

ii) Design the filter components for a buck converter which has an input voltage of 12 V and output voltage of 5 V. the peak to peak output ripple voltage is 20 mV and peak to peak ripple current of inductor is limited to 0.8 A. the switching frequency is 25 KHz.

7. i) Discuss the principle of operation of DC-DC step down chopper with suitable waveforms. Derive an expression for its average DC output voltage. Nov/Dec 06
ii) A step down DC chopper has input voltage of 230 V with 10 Ω load resistor connected, voltage drop across chopper is 2 V when it is ON. For a duty cycle of 0.5, calculate: 1) Average and r.m.s values of output voltage 2) Power delivered to the load

8. i) Discuss the need for resonant switching in SMPS. Nov/Dec 06
ii) Describe briefly the principle of operation of buck- boost converter with a neat circuit.

9. Draw the circuit 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

10. Draw the circuit of cuk regulator and explain its working principle with necessary waveforms in detail.

11. A step up chopper has input voltage of 220 V and output voltage of 660 V. If the nonconducting time of thyristor chopper is 100 micro sec compute the pulse width of output voltage. In case the pulse width is halved for constant frequency operation , find the new output voltage.

12. Classify the basic topologies of switching regulators and explain the operation of buck regulators with continuous load current using suitable waveforms.

13. Discuss the operation of the resonant switching based SMPS.

14. i) A dc chopper has an input voltage of 200 V and a load of 20 Ω resistances. When chopper is on, its voltage drop is 1.5 V and the chopping frequency is 10 KHz. If the duty cycle is 80%, find.

1) Average output voltage
2) RMS output voltage
3) Chopper on time
ii) Explain about type- E chopper.

UNIT-IV

INVERTERS

PART A

1. A single phase full bridge inverter has a resistive load of R = 10 Ω and the input voltage Vdc of 100 V. Find the rms output voltage at fundamental frequency.

2. List the application of CSI

3. Distinguish between VSI and CSI

4. List a few industrial applications of inverters.

5. What is the purpose of connecting diode in antiparallel with thyristors in inverter?

6. What is PWM? List its various techniques

7. What are the main differences between current driven and voltage driven inverter?

8. Define modulation index of PWM. What is its use?

9. What is the need for voltage control in an inverter?

10. What are the modulation techniques used in an inverter?
11. Define modulation index in PWM employed in inverter.

12. Mention any two advantages of current source inverter.

13. Define the term inverter gain

14. What is a current source inverter?

15. What are the advantages of PWM inverter?

16. What is the main drawback of a single phase half bridge inverter?

17 .What types of inverters require feedback diodes?

18. What is the condition to be satisfied in the selection of L and C in a series inverter?

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

20. What are the applications of a CSI?

PART B

1. Describe the operation of series inverter. What are its advantages?

2. State different methods of voltage control in inverters. Describe about SPWM control in inverter

3. i) Explain the principle of operation of single phase half bridge inverter.

ii) The single phase half bridge inverter has a resistive load of 2.4 Ω and the dc input voltage is 48 V. determine the r.m.s output voltage at the fundamental frequency, output power and the total harmonic distortion.

4. i) Describe with a neat sketch and waveform the operation of a single phase half bridge inverter supplying RL load.

ii) Discuss the application of PWM technique in the inverter, bring out its use.

5. With neat diagram and waveform, explain three phase voltage source inverter, using transistors operating in 180^{o} conduction mode. Also obtain the expression for rms value of output voltage.

6. With aid of circuit diagram and relevant waveforms, explain the operation of PWM inverters.

7. i) Compare CSI with VSI.

ii) Explain the operation of a single phase capacitor commutated CSI with R load with equivalent circuit and output waveform.

8. Explain using a diagram the operation of a series inverter. Bring out its limitations, develop the circuit of a modified series inverter.

9. i) With a neat diagram explain the single pulse width modulation method of voltage control of inverters.

ii) Discuss a few applications for inverters.

10. i) Describe the working of a single phase full bridge inverter supplying R, RL loads with relevant circuit and waveforms.

ii) What is PWM? List the various PWM techniques and explain any one of them.
11. With a neat circuit and relevant waveforms discuss the operation of an ideal single phase CSI.

12. Explain the following PWM techniques used in inverter.
i) Sinusoidal PWM
ii) Multiple PWM

13. Discuss the functioning of three phase voltage source inverter supplying a balanced star connected load in 120^{o} operating mode.

14. i) Write short note on series resonant inverter.
ii) Explain how inverter can be controlled using multiple and sine PWM techniques.

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 1Φ capacitor commutated current source inverter and explain its operation with equivalent circuits for different modes and necessary waveforms.

2. Explain the operation of multistage control of AC voltage controllers with neat diagram.

3. .Explain the operation of 1Φ AC voltage controller with RL load.

4. Explain the operation of sequence control of AC voltage controller..

5. Explain the operation of 1Φ sinusoidal AC voltage controller..

6. For a 1Φ voltage controller, feeding a resistive load, draw the waveforms of source voltage, gating signals, output voltage and voltage across the SCR. Describe the working with reference to waveforms drawn.

7. Explain in detail the operation of the matrix converter

8. Explain in detail the operation of the 3Φ cyclo converter

9. Describe integral cycle control with neat diagrams

10. Describe power factor control with neat diagram