

Code No: R31024

R10

Set No: 1

III B.Tech. I Semester Supplementary Examinations, May 2013

**POWER ELECTRONICS**

(Electrical and Electronics Engineering)

**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Define turn-on and turn-off times of an SCR.  
(b) Discuss the conditions which must be satisfied for turning on an SCR with gate signal.  
(c) Define latching and holding currents as applicable to an SCR.  
(d) Show these currents on V-I characteristics of SCR.
2. (a) What is commutation? Discuss different methods of commutation.  
(b) What is an UJT? Explain how it is used for triggering an SCR through its characteristics.
3. A DC battery is charged through a resistor R, by a single phase, one-pulse thyristor controlled rectifier. For an ac source voltage of 230V, 50Hz, find the value of average charging current for  $R = 10\Omega$ ,  $E = 110V$  and firing angle delay is  $30^\circ$ . Also calculate the power delivered to the battery and that dissipated in the resistor.
4. Describe the operations of a single-phase, two-pulse midpoint converter with relevant voltage and current waveforms. Discuss how each SCR is subjected to a reverse voltage equal to double the supply in case turns ratio from primary to each secondary is unity. Find the circuit turn-off time provided to each SCR by this converter configuration.
5. Explain the operation of three phase full converter connected to resistive load with circuit diagram and waveforms, when  $0 < \alpha < \pi/3$ .  
Obtain the average output voltage expression for this firing angle range.
6. A single-phase, full wave, ac voltage regulator has an input voltage of 250V (rms) and a load of 50ohm resistance. The delay angle of each thyristor is  $90^\circ$ . Find rms output voltage, load current and average thyristor current. Sketch the wave shapes of output voltage, load current, current through the thyristor and voltage across the thyristor.
7. Draw the power circuit diagram of type-A chopper. Show the load voltage waveform, when the duty cycle is 0.3. Calculate
  - (i) average output voltage
  - (ii) rms output voltage
  - (iii) output power in case of resistive load, R
  - (iv) ripple factor
8. (a) Explain about simple SCR series inverter circuit and its limitations.  
(b) Explain sinusoidal pulse modulation as used in PWM inverters

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1. (a) Draw the V-I characteristics of SCR and indicate clearly the operating region. Discuss salient points of these characteristics.  
(b) A thyristor is conducting forward current. Discuss the basic requirements for commutating this SCR.
2. (a) Discuss RC full wave trigger circuit for an SCR when the load is (i) ac type (ii) dc type.  
(b) What is commutation? Discuss any two methods of commutation in detail.
3. For a single phase, one pulse controlled converter system, sketch waveforms for load voltage and load current for (i) RL-load and (ii) RL-load with freewheeling diode across RL. From the comparison of these waveforms, discuss the advantages of using a freewheeling diode.
4. Describe the working of a single phase, full converter in the rectifier mode with RLE load. Discuss how one pair of SCRs is commutated by an incoming pair of SCRs. Illustrate your answer with necessary waveforms. Derive an expression for the average output voltage in terms of source voltage and firing angle.
5. (a) Derive the expression for average output voltage of 3- $\Phi$  full converter connected to R-load, when  $0 < \alpha < \Pi/3$ .  
(b) Explain the operation of a 3- $\Phi$  dual converter in circulating mode.
6. (a) What is an AC voltage controller? Describe the two types of ac voltage controllers and list out some of their industrial applications.  
(b) Explain the working of single-phase, midpoint cycloconverter. Draw the relevant waveforms for  $f_o = f_s/4$ .
7. Draw the power circuit diagram for a type-A chopper. Show the load voltage waveforms for (i)  $\alpha = 0.3$  and (ii)  $\alpha = 0.8$ . For both these duty cycles, calculate  
(a) The average and rms values of output voltage in terms of source voltage,  $V_s$ .  
(b) The output power in case of resistive load, R.
8. (a) Explain the operation of basic series inverter? List a few industrial applications of inverters.  
(b) What is pulse width modulation? List the various PWM techniques. How do these differ from each other?

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Set No: 3

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**POWER ELECTRONICS**

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**Time: 3 Hours****Max Marks: 75**

Answer any FIVE Questions  
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1. (a) What is a thyristor? Discuss its operation with the help of its symbol and static characteristics.  
(b) Discuss the turn-on and turn-off timings in a thyristor. Sketch the current and voltage waveforms of scr during both these processes?
2. (a) Write short notes on series and parallel connections of SCRs.  
(b) Discuss, with relevant waveforms, class A and class D types of commutations employed for thyristors.
3. (a) Describe the working of a single-phase, one pulse. SCR controlled converter with RLE load through the waveforms and circuit diagram.  
(b) A DC battery is charged through a resistor 'R' by a single phase, one-pulse thyristor controlled rectifier. For an ac source voltage of 230V, 50Hz, find the value of average charging current for  $R = 8\Omega$  and  $E = 150V$ . Assume that SCR is fired continuously.
4. (a) Describe the working of single phase fully controlled bridge converter in the following two modes: (i) rectifying mode (ii) inversion mode  
(b) Sketch the following waveforms of single phase fully controlled converter for firing angles  $45^\circ$  and  $20^\circ$ 
  - (i) load voltage and current waveforms
  - (ii) thyristor voltage and current waveforms
  - (iii) supply voltage and current waveforms
5. Explain the operation of 3-phase full converter connected to R-load. Draw the output voltage wave form, for a firing angle of  $30^\circ$ , obtained by using phase voltages. Derive the expression for average output voltage for the above case.
6. (a) What is an AC voltage controller? Describe the two types of ac voltage controllers and list out some of their industrial applications.  
(b) Explain the working of single-phase, bridge type cycloconverter with R-load. Draw the relevant waveforms for  $f_o = fs/2$ .
7. A chopper, fed from a 220V dc source, is working at a frequency of 50Hz and is connected to an RL-load, of  $R = 5\Omega$  and  $L = 40mH$ . Determine the value of duty cycle at which the minimum load current will be 5A.  
Calculate the corresponding value of maximum current and ripple factor.
8. (a) Explain the simple SCR inverter circuit employing class A-type commutation. Sketch the limitations of this inverter.  
(b) State different methods of voltage control in inverter. Describe about PWM control in inverter.

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1. (a) A thyristor is conducting forward current. Discuss the basic requirements for commutating this SCR.  
(b) Discuss any two methods in detail by which thyristors can be triggered into conduction.
2. (a) Explain any two commutation circuits used for thyristors in detail.  
(b) Discuss the significance of  $di/dt$  and  $dv/dt$  in case of thyristors.
3. An RL load is fed from 1- $\Phi$  supply through a thyristor. Derive an expression for load current in terms of supply voltage, frequency, R, L etc. Indicate the time limits during which this solution is applicable.  
For this thyristor-load combination, draw waveforms for load voltage, load current, source current and voltage across the thyristor.
4. A single phase full wave controller supplies an R-load of 5ohms. The input rms voltage is 220V at 50Hz. The delay angle of thyristors are equal as  $\alpha_1 = \alpha_2 = 90^\circ$ . Calculate
  - (i) the conduction angle of thyristor 1.
  - (ii) the rms value of output voltage and current
  - (iii) the rms and average value of thyristor currents
  - (iv) input power factor
5. Explain the operation of three-phase full converter connected to a resistive load. Draw the output voltage waveforms for (i)  $0 < \alpha < \Pi/3$  and (ii)  $\Pi/3 < \alpha < 2\Pi/3$   
Derive the expression for average out put voltage, when  $0 < \alpha < \Pi/3$ .
6. (a) Explain the operation of a 1- $\Phi$ , ac voltage regulator connected to R-load.  
(b) Explain the principle of a cycloconverter using a simple diagram. What is meant by positive group and negative group converters?
7. (a) What is a chopper? How is chopper controlled? Why forced commutation is necessary for choppers?  
(b) A DC chopper has an input voltage of 230V and an output voltage of 150V. It is operating at a frequency of 1 kHz. Find the periods of conduction and blocking each cycle.
8. (a) Briefly discuss the different methods by which voltage control can be done externally in an inverter.  
(b) A series inverter has  $R = 100\Omega$ ,  $L = 10\text{mH}$  and  $C = 1.3\mu\text{F}$ . If the SCR turn-off time is  $12\mu\text{s}$ , find the output frequency.

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