National Institute of Technology Delhi

End Semester Examinations May 2018

Name of Specialization: Electrical & Electronics Engg   Year: Third   Semester: VI

Course Name: Power Electronics   **Maximum Marks – 50**

Course Code: EEB-351   **Total Time: 3:00 Hours**

Note:
- All Questions are compulsory.
- Do not write irrelevant theory and draw neat waveforms and circuit diagrams.
- Assume data where ever required.

Section A (*01 mark each and all parts are compulsory*)

Q1) Draw the circuit diagram of Two-phase chopper.   (1)

Q2) What do you mean by SPWM. Discuss.   (1)

Q3) Write the disadvantages of harmonic reduction by transformer connections.   (1)

Q4) Draw the circuit diagram of single-phase capacitor commutated CSI with R load.   (1)

Q5) Define burst firing?   (1)

Q6) Mention the applications of cycloconverter.   (1)

Q7) In type-A chopper, per unit ripple in the load current is maximum when the duty cycle is equal to....   (1)

Q8) Draw the circuit diagram of three-phase dual converter.   (1)

Q9) Explain what you mean by Thermal triggering in thyristor.   (1)

Q10) Draw the symbol of IGBT and MOSFET. Mark their respective terminals.   (1)

Section B (*Any four (04) are to be attempted*)

Q11) Discuss the two-transistor model of a thyristor. Derive an expression for the anode current.   (5)

Q12) Describe the working of a single-phase full converter in the inverter mode with RLE load. Illustrate your answer with waveforms for source voltage, E, load voltage and current, source current, current through and voltage across SCR. Assume continuous conduction. Should the average output voltage be more than E during inverter operation? Discuss.   (5)

Q13) A single-phase semi converter feeds power to RLE load. For discontinuous load current, draw the source voltage, output voltage, load current, source current and freewheeling diode current waveforms as a function of time when:
(a) extinction angle $\beta > \pi$ (b) extinction angle $\beta < \pi$ with $V_m \sin \beta < E$.
Explain how various waveforms are obtained and discuss their nature.   (5)

Q14) What is current limit control? How does it differ from TRC? Which of these control strategies is preferred over the other and why? (4)

How can a step-up chopper be used for the regenerative braking of dc motor? Discuss. (1)

Q15) A step down chopper, fed from 220V dc, is connected to RL load with R =10Ω and L = 150 mH. Chopper frequency is 1250 Hz and duty cycle is 0.5. Calculate (a) minimum and maximum values of load current (b) maximum value of ripple current (c) average and rms value of load current and (d) rms value of chopper current.

(1+1+2+1)

Section C (*Any two (02) are to be attempted*)

Q16) (I) Discuss the principle of working of a three-phase bridge inverter with an appropriate circuit diagram. Draw and explain phase and line voltage waveforms on the assumption that each thyristor conducts for 120^0. The sequence of firing of various SCRs should also be indicated in the diagram. (5)

(II) A three-phase bridge inverter delivers power to a resistive load from a 450 V dc source. For a star-connected load of 10Ω per phase, determine for both (a) 180 degree mode and (b) 120 degree mode,
(i) rms value of load current
(ii) rms value of thyristor current. (5)

Q17) (I) Describe the basic principle of working of single-phase to single-phase step-down cycloconverter for RL load for discontinuous load current for mid-point cycloconverter with the help of output voltage and current waveforms. Mark the conduction of various thyristors also. (6)

(II) A single-phase bridge-type cycloconverter has input voltage of 230 V, 50 Hz and load of R = 10 Ω. Output frequency is one-third of input frequency. For a firing angle delay of 30^0, calculate (a) rms value of output voltage (b) rms current of each converter (c) rms current of each thyristor and (d) input power factor.

(4)

Q18)(I) A two-stage sequence controlled single-phase ac voltage controller is feeding a load of R = 20Ω. The source voltage is 230 V, 50 Hz and turns ratio from primary to each transformer secondary is unity. For two-stage sequence control, the firing angle of upper thyristors is 60^0. Calculate (a) rms value of output voltage (b) rms value of current for upper thyristors (c) rms value of current for lower thyristors (d) transformer VA rating and (e) input power factor. (5)

(II) Describe the working of a two-stage sequence control of voltage controllers for RL load along with its output voltage and current waveforms. (5)