Roll No.....

National Institute of Technology Delhi

End Semester Examinations May 2019

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 block diagram of a typical power electronic system. (1)

Q2) Mention the uses of freewheeling diode. (1)

Q3) Explain CDF. How does VRF related to FF. (1)

Q4) Mention the circuit turn-off time for single phase symmetrical semiconverter. (1)

Q5) What is TRC in dc choppers? (1)

Q6) Draw the circuit diagram for Type-E chopper. (1)

Q7) Discuss how distortion factor related to THD. (1)

Q8) Mention the disadvantages for Harmonic Reduction by Transformer connections. (1)

Q9) Explain duty cycle for ac voltage controller. (1)

Q10) Define cycloconverter. (1)

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

Q11) Explain the various mechanisms by which thyristors can be triggered into conduction. (5)

Q12) Show that the performance of a single phase full converter with the help of typical current and voltage waveforms as effected by source inductance is given by the relation

$$\cos(\alpha + \mu) = \cos\alpha - \omega L_s I_o / V_m$$

Where the symbols have their usual meaning. (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) Write voltage equations governing the performance of type-A chopper during T_{on} and T_{off} periods for RLE type load. Hence obtain there from expressions for the maximum and minimum values of load current in terms of source voltage V_s, R, E etc. (5)

Q15) A step-up chopper has input voltage of 220 V and output voltage of 660 V. If the conducting time of thyristor-chopper is 100μs, compute the pulse width of output voltage.
In case output voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. (3+2)

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 180^0. The sequence of firing of various SCRs should also be indicated in the diagram. (6)

(II) A single-phase full bridge inverter may be connected to a load consisting of (i) *R* (ii) *RL* (iii) *RLC* overdamped (iv) *RLC* underdamped. For all these loads, draw the load current waveforms under steady operating conditions. Discuss the nature of these waveforms. (4)

Q17) (I) What are the advantages of multistage over two-stage sequence control? Describe multistage sequence control of voltage controllers. Write down the advantages and disadvantages of two-stage sequence control over 1-phase full wave ac voltage controller. (6)

(II) A single-phase voltage controller has input voltage of 230 V, 50 Hz and a load of R = 15Ω. For 6 cycles on and 4 cycles off, determine (a) rms output voltage, (b) input pf and (c) average and rms thyristor currents. (4)

Q18)(I) Describe a single-phase capacitor –commutated CSI connected to load R with the help of its power circuit diagram and waveforms for gating signals, thyristor current, capacitor voltage and current, input voltage and voltage across one thyristor. (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)