Time: 3 Hours **Total Marks: 80**

NB: (1) Question No. 1 is compulsory.
(2) Attempt any three questions from remaining five questions.
(3) Assume suitable data if required but justify the same.
(4) Figures to the right indicate full marks

Q.1. Attempt any four from following **20**

a Describe different modes of operation of SCR with the help its static V-I characteristics and explain what is holding current and latching current.

b Explain single phase full-bridge inverter with R load.

c Explain with the help of neat circuit diagram and waveforms what the effect of freewheeling diode is on the performance of single phase half wave controlled rectifier with RL load.

d What are turn on methods of SCR? What are the basic requirements for successful turn on of SCR? Which is the best method of SCR triggering explain why?

e Describe the principle of on-off control and phase control.

Q.2. a Draw ramp and pedestal trigger circuit used for single phase semi converter. Describe its operation with appropriate waveforms **10**

b What are turning off methods of SCR. Explain the Class D commutation method with the help of neat circuit diagram and waveforms, also give the design concepts of class D commutation. **10**

Q.3. a Discuss the effect of source inductance on the performance of single phase fully controlled converter, indicating clearly the conduction of various thyristors during one cycle. Derive an expression for its output voltage in terms of **10**

(1) Maximum voltage E_m, Firing angle α and overlap angle μ.

(2) E_m, α, L_s (source inductance) and I_d (load current).

b A single phase fully controlled bridge converter supplies an inductive load. Assuming that the output current is virtually constant and is equal to I_d, determine the following performance measures, if the supply voltage is equal to 230 V and if the firing angle is maintained at (π/6) radians. **10**

(i) Average output voltage (ii) Supply RMS current (iii) Supply fundamental RMS current (iv) Fundamental power factor (v) Supply power factor
(vi) Supply harmonic factor (vii) Voltage ripple factor

Q.4. a Draw and explain the basic series inverter circuit employing class A type commutation. Draw and discuss the important waveforms. State the limitations of this series inverter. **10**

b A single phase full bridge inverter is operated from a 48 V battery and is supplying power to a pure resistive load of 10 Ω. **10**
Determine
(i) Fundamental output voltage and the first five harmonics.
(ii) RMS value by direct integration method and harmonic summation method.
(iii) Output RMS power and output fundamental power.
(iv) Transistor switches ratings.

Q.5. a. Draw the schematic of step-up and step-down choppers and derive an expression for output voltage in terms of duty cycle for a step-up and step-down chopper. **10**

b The input voltage to the boost DC-DC switch mode regulator is 6 V. The average output voltage is 18 V and the average load current is 0.4 A. The switching frequency is 20 KHz of L = 250 µH and C = 420 µF. Determine **10**
i) The duty cycle α, ii) The ripple current of inductor, iii) The peak current of inductor, and iv) The ripple voltage of filter capacitor

Q.6. Write a short note on **any three** of the following. **20**
(i) Single phase cyclo-converter
(ii) Battery charging systems
(iii) Static characteristics of IGBT
(iv) Protection of SCR against dv/dt, di/dt, over current and over voltage.

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