

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. A SCR is a Switch.
(a) two directional (b) unidirectional (c) three-directional (d) four-directional
- ii. It is recommended to use UJT oscillator for gate-triggering of the thyristors mainly because (a) it is fairly simple (b) it provides sharp firing pulses (c) it is less expensive (d) none of the above.
- iii. String efficiency is used for measuring the(a) voltage rating of SCRs (b) current rating of SCRs (c) temperature rating of SCRs (d) degree of utilization of SCRs
- iv. A single phase half wave controlled rectifier has $400 \sin 314t$ volts as the input voltage and resistor R is the load. For firing angle of 60° for the SCR, the average output voltage in volts is (a) $400/\pi$ (b) $300/\pi$ (c) $240/\pi$ (d) $360/\pi$
- v. For continuous conduction, in a single phase full converter each pair of SCRs conducts for (a) $(\pi - \alpha)$ radians (b) π radians (c) α radians (d) $(\pi + \alpha)$ radians
- vi. The effect of the source inductance on the performance of the single-phase and three-phase full-converters is to: (a) reduce the ripples in the load current (b) make discontinuous current as continuous (c) reduce the output voltage (d) increase the load voltage
- vii. A step-up chopper has V_s as the source voltage and a as the duty cycle. The output voltage for this chopper is given by: (a) $V_s(1 + a)$ (b) $V_s/(1 - a)$ (c) $V_s(1 - a)$ (d) $V_s/(1 + a)$
- viii. In a thyristor dc chopper, which type of commutation results in best performance: (a) voltage commutation (b) current commutation (c) load commutation (d) supply commutation
- ix. A single phase full-bridge inverter can operate in load commutation mode in case load consists of: (a) RLC overdamped (b) RLC underdamped (c) RLC critically damped (d) None of these
- x. The single pulse modulation of PWM inverters, third harmonic can be eliminated if pulse width is equal to: (a) 30° (b) 60° (c) 120° (d) None of these

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- i. Define circuit turn off time. Why circuit turn off time should be greater than the thyristor turn-off time?
- ii. What is meant continuous current operation of thyristor converter?
- iii. What is meant by PWM control in dc chopper?
- iv. What are the disadvantages of the harmonics present in the inverter system?

Q.3A What are the different signals which can be used for turning on an SCR by gate control? Compare them. 05

Q.3B A dc battery is charged through a resistor R as in figure. Derive an expression for the average value of charging current in terms of E_m , E_b , R, etc. on the assumption that SCR is fired continuously. (i) For an a.c. source voltage of 230 V, 50 Hz, find the value of average-charging current for $R=5 \text{ ohm}$ and $E_b=150 \text{ V}$. 05

(ii) Find the power supplied to battery and that dissipated in the resistor.
Calculate the supply power factor.

- Q.4A Describe the working of four quadrant chopper with relevant circuit diagrams and its operation in all the four quadrants. 05
- Q.4B Explain the principle of operation of single phase ac voltage controller having only thyristor feeding resistive load by on-off control and phase control. Derive the expression for rms value of output voltages in both cases. 05
- Q.5A A single phase full bridge inverter is operated from a 48 V battery and is supplying power to pure resistive load of 10 ohm. Determine: (i) the fundamental output voltage and first five harmonics (ii) rms value (iii) output rms power and output fundamental power 05
- Q.5B Explain the operation of the step down cycloconverter both bridge and midpoint configuration with necessary waveforms. 05
- Q.6A Explain the working principle of multiphase chopper. 05
- Q.6B Describe the operation of single phase full wave AC voltage controller with the help of voltage and current waveform. Also derive the expression for average value of output voltage. 05

OR

- Q.6B State the main features of firing circuits and briefly explain RC firing circuit with waveforms. 05
- Q.7A Why voltage control is needed in inverter circuits? State the various methods of voltage control in inverter circuits and explain each of them briefly. 05
- Q.7B (a) A single -phase controlled rectifier bridge consists of one SCR and three diodes, draw output voltage waveform for a firing angle α for the SCR and hence obtain an expression for the average output voltage under the assumption of continuous current. 05
(b) for an ac source voltage of 230 V, 50 Hz and firing angle of 45° , find the average output current and power delivered to battery in case load consists of $R=5$ ohm, $L=8$ mH and $E=100V$.

OR

- Q.7B Explain the voltage commutated chopper with associated voltage and current waveforms. 05
- Q.8A (a) A single -phase controlled rectifier bridge consists of one SCR and three diodes, draw output voltage waveform for a firing angle α for the SCR and hence obtain an expression for the average output voltage under the assumption of continuous current. 10
(b) for an ac source voltage of 230 V, 50 Hz and firing angle of 45° , find the average output current and power delivered to battery in case load consists of $R=5$ ohm, $L=8$ mH and $E=100V$.
- Q.9A A 3-phase bridge inverter delivers power to resistive load from a 450 volt dc source. For star connected load of 10 ohm per phase, Find: (a) RMS value of load current 10
(b) RMS value of thyristor current for 180 degree conduction mode.
- Q.9B Explain the operation of three phase dual converter with circulating and non-circulating current type. 10
- OR
- Q.9B A three pulse cycloconverter feeds a single phase load of 190 V, 45 Amp at a power factor of 0.7 lagging. Determine: (i) the required supply voltage (ii) thyristor rating (iii) power factor of the supply current. 10