

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)

- a. On insertion of an inductance in anode circuit of an SCR, the turn on time
- (A) decreases (B) increases
(C) remains the same (D) does not change much
- b. The sharing of the voltages between thyristors operating in series is influenced by their
- (A) $\frac{di}{dt}$ capabilities (B) $\frac{dv}{dt}$ capabilities
(C) Junction temperatures (D) Static v-i characteristics and leakage current
- c. A three phase half wave controlled converter feeds a resistive load. The load current will be continuous for all firing angles.
- (A) True (B) False
- d. A type-A chopper is operating at a frequency of 2 kHz on a 400 V supply. If the load voltage is 300 volts, the conduction period of the thyristor in each cycle is:
- (A) 0.375 ms (B) 0.375 sec
(C) 0.375 μ s (D) none of these
- e. A single phase voltage controller uses ON/OFF technique for controlling power fed to a resistive load. If the supply voltage is V and a duty ratio is k, the RMS output voltage will be
- (A) V (B) $\frac{V}{2}$
(C) $V\sqrt{k}$ (D) kV
- f. A 3-phase to 3-phase cycloconverter requires:
- (A) 18 SCRs for 3-phase device (B) 18 SCRs for 6-pulse device
(C) 36 SCRs for 3-phase device (D) 36 SCRs for 3-pulse device

- g. The speed of dc shunt motor above normal speed can be controlled by
- (A) Armature voltage control method
 - (B) Flux control method
 - (C) Both (A) & (B)
 - (D) None of the above
- h. PWM switching is preferred in voltage source inverters for the purpose of
- (A) Controlling output voltage
 - (B) Output harmonics
 - (C) Reducing filter size
 - (D) All of the above
- i. A free-wheeling diode is used in a controlled rectifier circuit in case of:
- (A) Resistive load
 - (B) Inductive load
 - (C) Capacitive load
 - (D) None of above
- j. A 3-phase voltage source inverter is operated in 180° conduction mode. Which one of the following statement is true?
- (A) Both pole voltage and line-voltage will have 3rd harmonic component
 - (B) Pole voltage will have 3rd harmonic component but line voltage will be free from 3rd harmonic.
 - (C) Line voltage will have 3rd harmonic component but pole voltage will be free from 3rd harmonic.
 - (D) Both pole voltage and line-voltage will be free from 3rd harmonic component

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

- Q.2** a. Discuss the two- transistor model of a thyristor. Using this model, describe the various mechanisms of turning on a thyristor. (10)
- b. What is GTO? Discuss its advantages over a normal thyristor? Describe the turn-off process of GTO. (6)
- Q.3** a. Describe the working of a single phase full converter in the inverter mode with RLE load. Illustrate your answer with waveform for source voltage, E , load voltage & current, source current, current through and voltage across one SCR. Assume continuous conduction. Find also the circuit turn-off time. (8)
- b. A 3- phase fully controlled bridge converter with 415V supply, 0.04 ohm resistance - per phase and 0.25ohm reactance per phase is operating in the inverting mode at a firing advance angle of 35° . Calculate the mean generator voltage when the current is level at 80A. The thyristor voltage drop is 1.5V. (8)
- Q.4** a. State the principle of chopper operation highlighting the operation of step down and step up chopper? Obtain the expression for the minimum and maximum currents for type-B chopper. (8)

- b. Draw and explain current and voltage waveforms for Impulse-commutated choppers. (8)
- Q.5** a. State the conditions for commutation of thyristor? (6)
- b. Develop the design equation for obtaining the values of L and C in resonant pulse commutating circuit. (10)
- Q.6** a. What is cycloconverter? Explain principle of a single phase cycloconverter. (6)
- b. Explain the circulating current mode operation of four quadrant cycloconverter. (10)
- Q.7** a. State different methods for voltage control of three phase inverter. (8)
- b. Explain, how does a single phase center-tapped inverter operates? Derive an expression for source current in center-tapped inverter. (8)
- Q.8** a. Explain on-off and phase control principle of AC voltage controllers. (8)
- b. Describe the operation of a single phase full wave ac voltage controller with resistive load and derive expression for average and RMS output voltages. (8)
- Q.9** a. Explain the operation of chopper drive for a dc separately excited motor in
- (i) Regeneration braking mode
- (ii) Rheostatic braking mode (8)
- b. Write notes on application of microprocessors in the control of electrical drives. (8)