

POWER ELECTRONICS CONVERTERS AND APPLICATION

Time Allowed: 3 Hours

Full Marks: 60

Answer to Question No. 1 of Group A must be written in the main answer script. In Question No. 1, out of 2 marks for each MCQ, 1 mark is allotted for right answer and 1 mark is allotted for correct explanation of the answer. However, no marks will be given for wrong explanation of the answer of each MCQ type question.

Answer any Five (05) Questions from Group-B.

GROUP-A

1. Choose the correct answer from the given alternatives and explain your answer (any ten): $2 \times 10 = 20$

i) The operation of an SCR can be explained by considering it as a) two NPN transistor, b) two PNP transistor, c) one NPN and one PNP transistor, d) two NPN and one PNP transistor.

ii) For J_1, J_3 as outer junctions and J_2 as middle junction of an SCR, in forward blocking mode
 a) J_2 is in reverse bias and J_1, J_3 is in forward bias, b) J_3 is in reverse bias and J_1, J_2 is in forward bias,
 c) J_1, J_3 is in reverse bias and J_2 is in forward bias, d) J_2 and J_3 is in forward bias and J_1 is in reverse bias.

iii) A step up chopper has input voltage 110 V and output voltage 150 V. The duty cycle of the chopper is nearly a) 32%, b) 67%, c) 45%, d) 27%.

iv) Which triggering method of SCR is the most reliable?
 a) Forward voltage triggering. b) Gate triggering c) dV/dt triggering. d) Thermal triggering.

v) When latching current of SCR is 20 mA, holding current will be
 a) 25 mA, b) 30 mA, c) 12mA, d) 27 mA.

vi) How can we protect SCR from thermal conditions?
 a) Use of snubber circuit, b) Using heat sink, c) Using MCB and fuse, d) Using equalizing circuit.

vii) ON state voltage drop across SCR lie between the range
 a) 0.5 – 1 V, b) 1.5 – 2 V, c) 2.5 – 3 V, d) 3.5 – 4 V.

viii) TRIAC is sensitive when operated as –
 a) MT2 positive, MT1 negative, Gate positive, b) MT2 negative, MT1 positive, Gate negative, c) MT2 negative, MT1 positive, Gate positive, d) both (a) & (b).

ix) For which of the following device turn on and turn off both are externally controllable?
 a) Silicon controlled switch, b) TRIAC, c) GTO, d) DIAC.

x) PWM inverter can change
 a) only magnitude of output voltage, b) only frequency of output, c) both magnitude of voltage and frequency of output, d) only pulse width of output.

xi) Which of the following members does not belong to thyristor family?
 a) Silicon controlled switch, b) TRIAC, c) MOSFET, d) DIAC.

xii) Cycloconverter can control
 a) only amplitude of output voltage, b) only frequency of output, c) both amplitude of voltage & frequency of output, d) only output current.

xiii) The form of output voltage obtained from UPS and SMPS respectively are
a) AC, AC, b) DC, DC, c) DC, AC, d) AC, DC.

xiv) When input of a half wave controlled rectifier using SCR is, $V=100 \sin \omega t$, the average voltage across resistive load at triggering angle 60° is –
a) $150/\pi$ V, b) $75/\pi$ V, c) $100/\pi$ V, d) $300/\pi$ V.

xv) Speed of AC induction motor can be controlled by
a) Controlled rectifier & inverter, b) PWM Inverter, c) DC Chopper & inverter, d) all the above devices.

GROUP-B

Answer any Five (05) questions

2. a) Draw V-I characteristics of SCR and label all the necessary parameters.
b) Write the name of turn ON methods of SCR. Explain DC gate triggering method of SCR with circuit diagram. [3+ (2+3)]
3. a) Describe the operating principle and application of TRIAC.
b) Explain use of Freewheeling Diode in controlled rectifier circuits.
c) Define latching current of SCR. [4+2+2]
4. a) Explain operation of single phase fully controlled bridge rectifier for R-L load with circuit diagram and load voltage, load current waveforms.
b) For a step down chopper input voltage is 160 Volt. If the switching time period is $T=40$ msec and ON time of chopper, $T_{ON}=25$ msec, what will be the output voltage? [5+3]
5. a) Explain with circuit diagram operation of class-C chopper.
b) Describe the operation of step down single phase cycloconverter with R-load. Draw the corresponding circuit diagram and output voltage waveforms. [4+4]
6. a) Explain with circuit diagram speed control method of separately excited DC motor by single phase fully controlled rectifier. Draw the corresponding output voltage waveforms and torque-speed characteristics.
b) Write two advantages of using PWM control in inverter circuit. [(3+3) +2]
7. a) Explain working principle of On-line UPS with block diagram.
b) Explain working principle of SMPS with block diagram. [4+4]
8. a) Explain with circuit diagram operation of single phase full bridge inverter using SCR for resistive load. Draw the corresponding load voltage, load current waveforms.
b) Write name of four commutation methods of SCR. [(3+3) +2]
9. a) Describe speed control method of 3-phase induction motor with variable voltage variable frequency control.
b) Explain the use of snubber circuit with necessary circuit diagram. [5+3]
10. Write short notes on the following (any two): [4x2]
a) Basic series inverter
b) Class-C commutation of SCR
c) Working principle and application of DIAC
d) Working principle of GTO and its application