

## POWER ELECTRONICS CONVERTERS AND APPLICATION

*Time Allowed: 2.5 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.**

**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) A TRIAC can be considered as a combination of – a) two SCRs in series, b) two SCRs back to back connection, c) two diodes back to back connection, d) one diode and one SCR back to back connection.
  - ii) TRIAC is most sensitive when operating with – a) MT2 positive, negative Gate current, b) MT2 negative, positive Gate current, c) MT2 positive, positive Gate current, d) both b & c.
  - iii) The device that has more than one gate terminal is – a) SCR, b) TRIAC, c) GTO, d) SCS.
  - iv) R-C triggering of SCR is preferred over resistance triggering because it – a) provides a larger value of the triggering angle, b) provides accurate triggering, c) provides quick triggering, d) requires less amount of energy.
  - v) For an SCR, the  $dv/dt$  protection is achieved through the use of – a) R-L in series with the SCR, b) R-C in parallel with the SCR, c) L in series with the SCR, d) R-C in series with the SCR.
  - vi) In a single-phase full-wave controlled rectifier using mid-point converter with R-L type load, if the input voltage is given from 100-0-100V transformer, the PIV of each SCR will be – a) 200 V, b) 345 V, c) 100 V, d) 400 V.
  - vii) A freewheeling diode is used in a controlled rectifier circuit in the case of – a) Resistive load, b) Inductive load, c) Capacitive load, d) all of a, b & c.
  - viii) A single-phase full bridge inverter uses – a) one SCR, b) two SCRs, c) four SCRs, d) two SCRs and two diodes.
  - ix) In a three-phase full-wave fully-controlled bridges rectifier, each SCR conducts for a duration of – a)  $120^\circ$ , b)  $60^\circ$ , c)  $45^\circ$ , d)  $30^\circ$ .
  - x) In a 110V DC chopper using Current Limit Control (CLC), the chopper ON and OFF periods are 20ms and 15ms respectively. The duty cycle of chopper is – a) 0.42, b) 0.57, c) 0.75, d) 0.82.
  - xi) Both forward motoring and forward braking operation can be obtained from chopper – a) class-A type, b) class-B type, c) class-C type, d) class-D type.
  - xii) Reverse braking operation of motor belongs to – a) Quadrant-I, b) Quadrant-II, c) Quadrant-III, d) Quadrant-IV.
  - xiii) When the speed of the DC motor falls below the normal speed, the SCR fires – a) earlier, b) later, c) at the same angle, d) according to its anode voltage.
  - xiv) SPMS are based on the principle of – a) Phase control, b) Integral control, c) Chopper, d) MOSFET.
  - xv) The part of an On-line UPS is – a) rectifier, b) inverter, c) charger, d) all of a, b & c.

**GROUP-B**  
**Answer any Five (05) questions.**

2. a) Explain with diagram two-transistor analogy of the SCR.  
b) Define the following of a SCR: (i) Latching current, (ii) Holding current, (iii) Forward break over voltage. [4+ (1x4)]  
(iv) On-state voltage drop.
3. a) Draw and explain V-I characteristics of a DIAC.  
b) Describe the construction of a TRIAC. [3+3+2]  
c) Write an application of a DIAC with a circuit diagram.
4. a) With the help of a circuit diagram, explain the working principle of a single-phase controlled half-wave bridge rectifier using SCR with a combination of resistive and inductive load. Draw the corresponding waveform of load voltage, load current and voltage across SCR.  
b) Briefly explain the difference between the self and natural commutation of an SCR. [5+3]
5. a) Explain with circuit diagram the operation of a single phase cycloconverter whose output frequency of the load voltage is 1/4th of the input supply frequency.  
b) Derive the expression for the average output voltage of a step up chopper. [5+3]
6. a) Explain how pulse width modulation (PWM) control can be applied for a single phase half bridge inverter.  
b) Explain with circuit diagram the operation of a basic series inverter. [4+4]
7. a) A chopper circuit operating on Time Ratio Control (TRC) principle at a frequency of 1kHz on a 230V DC supply. If the output load voltage is 180V, calculate ON and OFF period of the chopper switch in each cycle.  
b) Draw and explain single-phase full-wave full controlled converter drive for controlling a separately-excited d.c. motor. [3+5]
8. a) Describe with circuit diagram the working principle of R-C triggering circuit of SCR.  
b) Explain Class-A commutation method of SCR with circuit diagram. [4+4]
9. a) Describe with circuit diagram the working principle of On-line UPS.  
b) Explain the working principle of SMPS with block diagram. [4+4]
10. Describe (any two) of the following: [4x2]  
a) Operation of parallel inverter with circuit diagram.  
b) Operation of IGBT with circuit diagram.  
c) Operation of class-B chopper with circuit diagram.  
d) Speed control of induction motor using variable voltage variable frequency control.
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