WEST BENGAL UNIVERSITY OF TECHNOLOGY

EE-603

POWER ELECTRONICS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) The number of p-n junction in a thyristor is/are

(A) 1 (B) 2 (C) 3 (D) 4

(ii) In a three phase semi-converter the three SCRs are triggered at an interval of

(A) 60° (B) 90° (C) 120° (D) 180°

(iii) SCR used

(A) no gate
(B) one gate on p-layer next to cathode
(C) one gate on n-layer next to anode
(D) two gates

(iv) In SCR, the turn-off time; where T is the temperature in K

(A) increases with T (B) is independent of T
(C) varies as 1/T (D) varies as $1/T^2$

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(v) In SCR, the turn-on time

(A) increases with T
(B) is independent of ambient temperature T
(C) varies as 1/T
(D) varies as $1/T^2$

(vi) Presence of drift layer in a power semiconductor device

(A) increases breakdown voltage rating
(B) increases on state current rating
(C) increases switching speed
(D) decreases on state resistance

(vii) In UJT, with V_{BB} as the voltage across two base terminals, the emitter potential at peak point is given by

(A) ηV_{BB} (B) ηV_D (C) $\eta V_{BB} + V_D$ (D) $\eta V_D + V_{BB}$

(viii) In a three phase full wave rectifier, the output voltage pulsates at a frequency equal to supply frequency,

(A) f (B) $2f$
(C) $3f$ (D) $6f$

(ix) For continuous conduction each thyristor pair of a two pulse full converter should conduct for

(A) π (B) $\pi - \alpha$ (C) α (D) $\pi + \alpha$

(x) Chopper control of DC motor provides variation in

(A) input voltage (B) current (C) frequency (D) all of these

(xi) A single phase full bridge VSI has inductive load. For a constant source voltage, the current through the load is

(A) square wave (B) triangular wave
(C) sine wave (D) pulsed wave

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Discuss about softness factor PIV, reverse recovery current for power diodes. 5

3. What is snubber circuit? Why snubber circuits are used in thyristor circuits? 2+3

4. Describe the effect of source inductance on the DC output voltage of a single phase full controlled bridge rectifier. 5

5. Explain briefly the working of class B chopper with diagram. 5

6. What is PWM inverter? What are its advantages? 3+2

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) What are the conditions for successful turn-on and communication of an SCR? 4+5+6
   (b) What are the different methods to turn-on an SCR?
   (c) With the help of two transistor model, explain how a small gate current can initiate turn-on mechanism in SCR.

8. (a) In a buck converter find a relationship to show that amplitude of ripple current depends upon duty cycle. From the relationship how can the value of duty cycle be decided for maximum ripple current amplitude? 5+5+5
   (b) A buck converter has input voltage 220 V and it operates at 500 Hz. The average load current is 50 A. The load resistance is 2 Ohm. What will be the value of inductance to limit maximum peak to peak ripple current through inductor to 10%? Find the value of inductance for maximum ripple current.
   (c) What is meant by PWM control in chopper? Explain the working principle of four quadrant chopper.

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9. (a) Explain the principal operation of a inverter. 4+2+5+4
   (b) What is the reason behind using feedback diodes in anti parallel with SCRs in inverter?
   (c) Compare 180° and 120° conduction mode's 3 phase bridge inverter.
   (d) What is PWM triggering? What is the difference between voltage source and current source inverter?

10. (a) Draw the circuit of a two quadrant chopper & explain its working. 5+5+5
   (b) A step down DC chopper has a resistive load of R=15ohm and input voltage Edc=200V. When the chopper remains on, its voltage drop is 2-5V. The chopper frequency is 1kHz. If the duty cycle is 50%, determine
      (i) average output voltage
      (ii) RMS output voltage
      (iii) chopper efficiency.
   (c) Derive an expression for output voltage in terms of duty cycle for a step-up and step-down chopper.

11. Write short notes on any *three* of the following: 5×3
   (a) Application of power semiconductor devices to HVDC system
   (b) Induction heating
   (c) Rectifier fed DC motor control
   (d) GTO
   (e) Parallel operation of SCRs.

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