Total No. of printed pages = 7

CAI-504/PE/5th Sem/2017/N

POWER ELECTRONICS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

PART – A

Marks – 25

1. Determine the correct options for the following questions : 1×10=10

   (i) An SCR is triggered at 40° in the positive half cycle only. The average anode current is 50A. If the firing angle is changed to 80°, the average anode current is likely to be

   (a) 50A

   (b) less than 50A but more than 25A

   (c) 25A

   (d) less than 25A

(ii) In a step down chopper using pulse width modulation, $T_{on} = 3\times10^{-3}$ and $T_{off} = 1\times10^{-3}$ s. The chopping frequency is

(a) 333.33

(b) 500

(c) 250

(d) 1000

(iii) The Schottky barrier diode has

(a) Semiconductor-semiconductor contact

(b) Metal-semiconductor contact

(c) Metal-metal contact

(d) None of the above

(iv) Average load current supplied by a thyristor depends on

(a) firing angle

(b) magnitude of gate current

(c) firing frequency

(d) All of the above

(v) A thyristor is reverse biased. A positive gate pulse is applied. The thyristor

(a) will be turned on

(b) will not turn on

(c) may or may not turn on

(d) will turn on after sometime

(vi) A single phase half wave controlled rectifier circuit has an R-load. A freewheeling diode is also in the circuit. When freewheeling diode is conducting the SCR

(a) is forward biased

(b) is reverse biased

(c) may be forward biased or reverse biased

(d) forward biased initially but reverse biased afterwards

(vii) The number of doped regions in a SCR is

(a) 2 (b) 3

(c) 4 (d) 5

(viii) Second breakdown is present in

(a) MOSFET (b) BJT

(c) IGBT (d) SCR

(ix) A thyristor needs protection against

(a) high dv/dt

(b) high di/dt

(c) both high dv/dt and high di/dt

(d) either high dv/dt or high di/dt

(x) In an SCR, the anode current is controlled by

(a) gate current only

(b) external circuit only

(c) both gate current and external circuit

(d) None of the above

2. State whether the following statements are true or false : 1×10=10

(i) A DIAC has two terminal, anode and cathode.

(ii) In 180° mode of operation of a 3 phase bridge inverter, two thyristors conduct at one time.

(iii) SCR can be turned on by applying a negative gate pulse.

(iv) In a chopper circuit the output voltage depends on turn on time only.

(v) A TRIAC has 6 semiconductor regions.

(vi) UJT is a three terminal device.

(vii) The peak inverse voltage of bridge rectifier is one-fourth of peak inverse voltage of half wave rectifier.

(viii) The speed of a DC motor depends only on the number of stator poles.

(ix) The equivalent circuit of IGBT consists of two BJTs.

(x) For $\alpha = 0$, the output voltage of controlled rectifier is same as that of diode rectifier.

3. Fill in the blanks : 1×5=5

(i) BJT has _____ on state loss compared to MOSFET.

(ii) IGBT is a _____ controlled device.

(iii) A three phase controlled bridge rectifier has _____ SCRs.

(iv) Holding current of SCR is _____ than latching current.

(v) Type-A chopper is _____ quadrant chopper.

PART – B

Marks – 45

4. Draw the I-V characteristics of an SCR and define the terms— forward blocking region, latching current and holding current. 5

5. If for a GTO $I_a = 2A$, $I_k = 1.8A$ and $I_g = -2.1A$, determine the turn off gain, β_{off}. 5

6. A single phase 230V, 1 kW heater is connected across single phase 230V, 50 Hz supply through an SCR. For firing angle of 45° and 90°, calculate the power absorbed in the heater element. 5

7. Why the output voltage of a half wave controlled rectifier with RL load is not zero even when the input voltage changes its phase from positive to negative ? Draw the waveform of input voltage, output voltage, output current, and voltage across thyristor of a single phase half wave controlled rectifier. 2+4=6

8. A step up chopper has input voltage of 220V and output voltage of 660V. If the conducting time of thyristor-chopper is 100 μs, compute the pulse width of output voltage. In case output voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. 5

9. Give the steady state analysis of a single phase inverter. 5

10. Write short notes on any *two* : 7×2=14

    (a) UPS

    (b) Single phase cyclo converter

    (c) Speed control of DC motor

    (d) SMPS.