Total No. of printed pages = 7

END SEMESTER EXAMINATION-2021

Semester : 5th (New)

Subject Code : CAI-504

POWER ELECTRONICS

Full Marks – 70

Time – Three hours

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

Instruction :

The question paper consists of two parts : PART–A and PART–B both are compulsory.

PART–A

Marks –25

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

   (i) Which is not a method of SCR turn on ?

   (a) gate triggering

   (b) dv/dt triggering

   (c) negative gate triggering

   (d) light triggering

[Turn over

(ii) The Schottky barrier diode has

(a) Semiconductor-semiconductor contact

(b) Metal-semiconductor contact

(c) Metal-metal contact

(d) None of the above

(iii) IGBT is a

(a) Current controlled device

(b) Voltage controlled device

(c) Phase controlled device

(d) None of the above

(iv) 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 forwarded biased or reverse biased

(d) forward biased initially but reverse biased afterwards

(v) Second breakdown is present in

(a) MOSFET (b) BJT

(c) IGBT (d) SCR

(vi) A thyristor can be protected against high dv/dt by

(a) connecting an inductor in series with the thyristor

(b) connecting a capacitor in series with the thyristor

(c) connecting an inductor in parallel with the thyristor

(d) connecting a capacitor in parallel with the thyristor

(vii) Type A chopper operates in

(a) 4th quadrant (b) 2nd quadrant

(c) 1st quadrant (d) 3rd quadrant

(viii) Inverter converts

(a) AC to DC (b) DC to DC

(c) AC to AC (d) DC to AC

(ix) The condition for step up operation for a step up/step down chopper is

(a) $0 \leq \alpha \leq 0.5$ (b) $0.5 \leq \alpha \leq 1$

(c) $\alpha = 0$ (d) $\alpha = 1$

(x) In a step down chopper, if Vs = 100 V and the chopper is operated at a duty cycle of 75%. Find the output voltage.

(a) 100 (b) 75

(c) 50 (d) 0

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

(i) GTO can be turned off by applying a negative gate pulse.

(ii) A TRIAC has 6 semiconductor regions.

(iii) UJT is a three terminal device.

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

(v) SCR remains turned on after removal of the gate signal.

(vi) Type E chopper is a 2 quadrant chopper.

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

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

(ix) In a chopper circuit the output voltage can be varied by varying duty cycle.

(x) Output of a phase controlled rectifier will be same as the output of a diode rectifier if firing angle, $\alpha = 90^{\circ}$.

3 Fill in the blanks : $1 \times 5 = 5$

(i) BJT has _____ on state loss compared to MOSFET. (higher/lower/equal)

(ii) Holding current of SCR is _____ than latching current. (higher/lower/equal)

(iii) _____ has negative resistance region in its I-V characteristics. (BJT/UJT/IGBT)

(iv) Cycloconverter converts _____ from one level to another level. (voltage/current/frequency)

(v) Duty cycle of a chopper is _____.

$$\left(\frac{T_{on}}{T_{off}} / \frac{T}{T_{on}} / \frac{T_{on}}{T}\right)$$

PART–B

Marks – 45

4 A DC battery is charged through a resistor R as shown in Fig. 1. Derive an expression for average value of charging current in terms of V_m, E, R etc. on the assumption that the SCR is fired continuously. 9

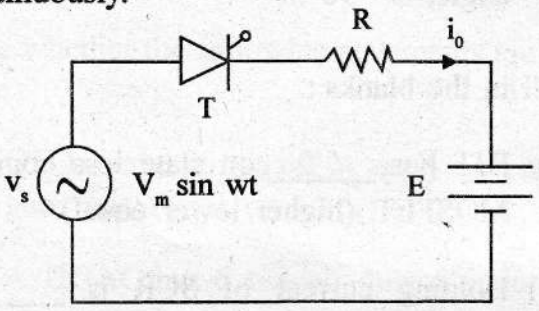

Fig. 1

(i) For an AC source of 230V, 50Hz find the value of average charging current if R = 8Ω and E = 150V.

(ii) Find the power supplied to the battery and that dissipated in the resistor.

(iii) Calculate the supply pf.

5 For a type a chopper of Fig. 2, DC source voltage = 230V and load resistance= 10Ω. The voltage drop across the chopper is 2 V when it is on. For a duty cycle of 0.4 calculate 6

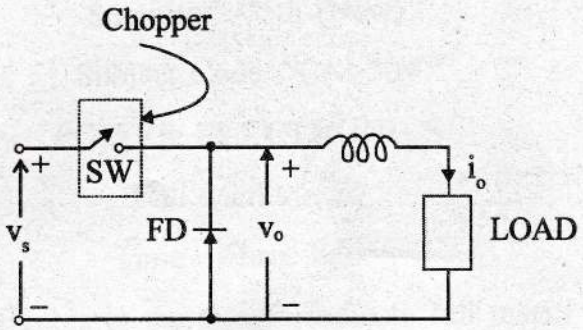

Fig. 2

(i) average and rms values of output voltage

(ii) chopper efficiency.

6 What is an Cycloconverter ? Explain the working principle of a single phase to single phase step up cycloconverter. 10

7 Explain the working of a single phase halfwave converter drive for DC motor control. 8

8 Give the steady state analysis and draw the load voltage and current waveforms of a single phase bridge inverter for R-load, RL-load and RLC-load. 7+1+1+1+2=12