Total number of printed pages = 4

19/6th Sem/UIE 611

2022

POWER ELECTRONICS

Full Marks – 100

Time – Three hours

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

Answer any *five* questions.

1. (a) What are the different types of power diodes ? How the reverse recovery time is significant in classification of power diodes ? 4

   (b) Draw the forward biased safe operating area and reverse biased safe operating area of a power BJT. 2+2=4

   (c) Write a comparison between power BJT and power MOSFET. 5

   (d) Explain the working of an IGBT. 7

[Turn over

2. (a) Draw the I-V characteristics of an SCR and define the terms – Holding current, Latching current and Forward break over voltage. 5

(b) Using two transistor analogy explain the turn off process of a GTO. 8

(c) What is equalization circuits. Derive the expression for equalization resistance of a series equalization circuit. 7

3. (a) What is a phase controlled rectifier ? Explain the working of a half wave phase controlled rectifier with RL-load. 2+8=10

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

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

For an AC source voltage of 230V, 50 Hz find the value of average charging current for $R = 8\Omega$ and $E = 150V$. 4

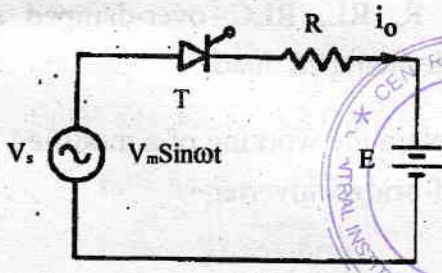

Fig. 1

4. (a) What is a chopper? Explain the control strategies of a chopper. 2+4=6

(b) For a type A chopper DC source voltage is 230V, load resistance is 10Ω. Voltage drop across the chopper is 2V when it is on. For a duty cycle of 0.4, calculate : 6

(i) average and rms values of output voltage.

(ii) chopper efficiency.

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

5. (a) What is an inverter ? Give the steady state analysis of a voltage source single phase bridge inverter and draw its output waveforms for R, RL, RLC–over-damped and RLC-under-damped load. 2+4+4=10

(b) Explain the working of a modified McMurray half-bridge inverter. 10

6. (a) What is a cycloconverter ? Explain the working of single phase to single phase step up cycloconverter. 2+8=10

(b) What is UPS ? Explain the different types of UPS. 2+8=10

7. Write short notes on : 10×2=20

(a) Single phase DC drives

(b) AC voltage Controllers.