Total number of printed pages–4

53 (IE 602) PWEL

2021

POWER ELCTRONICS

Paper : IE 602

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 is the reverse recovery time significant in classification of power diodes ? 2+3=5

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

Contd.

(c) Give a comparison of power MOSFET and power BJT. 5

(d) Explain the working of an IGBT. 6

2. (a) Draw the I-V characteristics of an SCR and define the terms—holding current, latchin current and forward breakover voltage. 5

(b) Using two-transistor analogy, explain the Turn Off process of a GTO. 10

(c) What is MCT ? How can an MCT be Turned On and Off ? 5

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

(b) A single-phase $230V$, $1kW$ heater is connected across 1-phase, $230V$, $50Hz$ power supply through an SCR. For firing angle delays of 45° and 90°, calculate the power absorbed in the heater element. 4

(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 $230V$, $50Hz$ find the value of average charging current for $R = 8\Omega$ and $E = 150V$, $V_S = V_m \sin\omega t$. 4+2=6

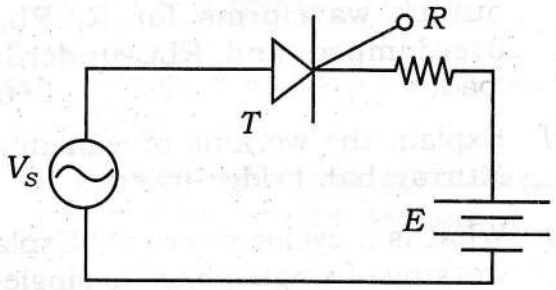

*Fig.*1

4. (a) What is a chopper ? Explain the control strategies of a chopper. 8

(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 –

(i) average and *rms* values of output voltage

(ii) chopper efficiency. 6

(c) A step-up choper has input voltage of 220V and output voltage of 660V. If the non-conducting time of thyristor-chopper is 100 μs, compute the pulse width of the output voltage. In case pulse width is halved for constant frequency operation, find the new output voltage. 6

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-overdamped and RLC-underdamped load. 2+6+4=12

(b) Explain the working of a modified MC Murray half-bridge inverter. 8

6. (a) What is a cycloconverter ? Explain the working of single-phase to single-phase step up cycloconverter. 10

(b) What is SMPS ? Explain *any one* configuration of SMPS. 10

7. (a) What is UPS ? Explain various types of UPS. 10

(b) Write short notes on : ***(any two)*** 5×2=10

(i) SIT

(ii) SCR protection circuits

(iii) DC motor control.