53 (IE 602) PWEL

2018

POWER ELECTRONICS

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)* Draw the I-V characteristics of an SCR. Define the terms — forward blocking region, holding current, latching current. 8

   (b) Give a comparison between Power MOSFET and BJT. 6

   (c) Draw the equivalent circuit of —

   (i) IGBT *(ii)* MCT 3×2=6

2. *(a)* How a GTO can be turned off ? Explain. 10

(b) How a thyristor can be protected against high dv/dt and high di/dt? Explain with neat diagram. 10

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

(b) 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 Vm, E, R, etc. on the assumption that SCR is fired continuously. 7

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

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

(iii) Calculate the supply pf.

(c) Explain the working of a single phase half wave controlled rectifier with RL load. 8

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. Take a voltage drop of $2V$ across chopper 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 chopper has input voltage of $220V$ and output voltage of $660V$. If the conducting time of thyristor-chopper is $100\mu s$, 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. 6

5. (a) What is an Inverter? Give the steady state analysis of a single phase inverter. 10

(b) Explain different modes of a modified McMurray Half bridge Inverter. 10

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

(b) A separately excited dc motor is supplied from 230*V*, 50*Hz* source through a single phase half wave controlled converter. Its field is fed through 1-phase semiconverter with zero degree firing-angle delay. Motor resistance $r_a = 0{\cdot}7\Omega$ and motor constant = 0·5*V sec/rad*. For rated load torque of 15*Nm* at 1000 *rpm* and for continuous ripple free currents, determine —

(i) firing-angle delay of the armature converter

(ii) *rms* value of thyristor and free wheeling diode currents

(iii) input power factor of the armature converter. 10

7. Write short notes on : 10×2=20

(a) UPS

(b) Cycloconverter.
