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)* How an SCR can be turned on and turned off ? 4+4=8

   (b) Give a comparison between BJT, MOSFET and IGBT. 5

   (c) How an SCR can be protected against high $\frac{di}{dt}$ and high $\frac{dv}{dt}$? 7

2. *(a)* Why equalization circuit is required for series and parallel operation of SCR ? 4

(b) Draw the equivalent circuit of MCT and IGBT. 4

(c) Draw and explain the working of a single phase half-wave rectifier with resistive load. If an inductor is also connected at the load, what changes will be seen in the output waveform and why the changes will occur ? 8+4=12

3. (a) If a single phase half-wave controlled rectifier with load $R=10k\Omega$ and $L=0{\cdot}1mH$ is supplied with an *ac* source of 10 *sin* $500t$, find the average and rms output voltage and current. 10

(b) Why a bridge converter is advantageous over a midpoint converter ? 5

(c) A single phase $220V$, $1kw$ heater is connected across a single phase $220V$, $60Hz$ supply through an SCR. For firing angle 20° and 40°, find the absorbed power. 5

4. (a) What is a Chopper ? What are the different control strategies of chopper ? Explain each. 1+2+6=9

(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 : 5

(i) average and rms values of output voltage

(ii) chopper efficiency.

(c) A step up/step down chopper has input *dc* voltage of $220V$ and output voltage of $660V$. If the conduction time of thyristor chopper is $120\mu s$, compute the pulse width load voltage.

In case pulse width of load voltage is increased to three times its previous width, for constant frequency operation, calculate the new value of average output voltage. 6

5. (a) Give the steady state analysis of a single phase inverter. Also draw the waveforms of output current of a single phase inverter for various loads. 7+5=12

(b) A single phase full bridge inverter has RLC load of $R=4\Omega, L=35mH$ and $C=155\mu F$. The *dc* input voltage is $230V$ and output frequency is $50Hz$. Find an expression for load current upto the fifth harmonic and calculate rms value of fundamental load current. 8

6. *(a)* A separately excited *dc* motor is supplied from $230V$, $50Hz$ 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 is $0{\cdot}5V - sec/rad$. For rated load torque of $15Nm$ at 1000 rpm and for continuous ripple-free currents, determine : 10

(i) firing-angle delay of the armature converter

(ii) rms value of thyristor and freewheeling diode currents

(iii) input power factor of the armature converter.

(b) Explain *any one* configuration of SMPS with neat diagram. 10

7. Write short notes on : 10×2=20

(a) Cyclo converter

(b) UPS.
