53 (IE 602) PWEL

2019

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) Give a comparison between Power MOSFET and BJT.   5

   (b) What is safe operating area ? Draw the safe operating area of a BJT.

        5

   (c) Draw the equivalent circuit of IGBT, MCT and SCR.   6

   (d) Define the terms : latching current and holding current.   4

2. (a) How an SCR can be protected against high di/dt and high dv/dt ?

6

(b) How DIAC and TRIAC differs from diode and SCR ?

4

(c) How a GTO can be turned off using negative gate pulse ? Explain.

10

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

10

(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 V_m, E, R etc. on the assumption that SCR is fired continuously.
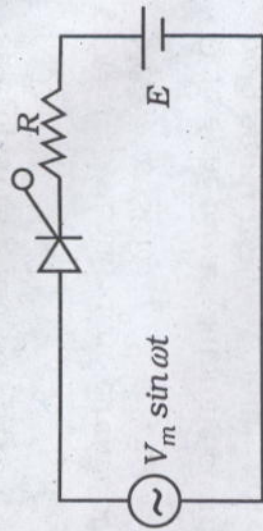

Fig. 1

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

6

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

(iii) Calculate the supply pf.

10

4. (a) 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 $12\mu s$, compute the pulse width of 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

(b) For a type-A chopper circuit, source voltage $V_s = 220V$, chopping period $T = 2000\mu s$, on period $= 600\mu s$, load circuit parameters : $R = 1\Omega, L = 5mH$, and $E = 24V$,

(i) find whether load current is continuous or not.

(ii) calculate the value of average output current.

(iii) compute the maximum and minimum values of steady state output current.

(iv) sketch the time variations of gate signal i_g, load voltage v_o, load current i_o, thyristor current i_T, freewheeling diode curent i_{fd} and voltage across thyristor V_T.

(v) find r.m.s values of the first, second and third harmonics of the load current.

(vi) compute the average value of supply current.

(vii) compute input power, the power absorbed by the load counter e.m.f and the power loss in the resistor.

(viii) compute r.m.s value of load current using the results (ii) and (vii).

(ix) using results of (v), find the r.m.s value of load current. Compare the result with that obtained in part (viii).   14

5. (a) Give the Fourier analysis of single phase inverter output voltage.   8

(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 the output frequency is 50Hz.

(i) Find an expression for load current upto fifth harmonic. Also calculate —

(ii) r.m.s value of fundamental load current.

(iii) The power absorbed by load and the fundamental power.

(iv) The r.m.s and peak currents of each thyristor.

(v) Conduction time of thyristors and diodes if only fundamental component is considered.   12

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

(b) Explain the working of short break and no break UPS.   10

7. Write short notes on :   10×2=20

(a) Cycloconverter

(b) Modified McMurray-Bedford full-bridge inverter.