53 (IE 602) PWEL

2017

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)* Define the terms : 6

Holding current, Latching current, forward blocking region.

Explain the significance of the above terms in SCR I-V characteristics.

(b) How an SCR can be protected against high $\frac{di}{dt}$ and high $\frac{dv}{dt}$? 3+3=6

(c) Compare a power BJT with power MOSFET. 4

(d) Draw the equivalent circuit of :

(i) IGBT

(ii) MCT. 2+2=4

2. (a) Using two transistor analogy explain how a GTO can be turned off using negative gate pulse. How the turning off process of GTO makes it advantageous over SCR ? 8+2=10

(b) What is a controlled rectifier ? Define the terms — firing angle and extinction angle. 5

(c) For a half wave controlled rectifier the supply voltage is $120 sin 314t$. If the output average voltage is $50V$ and the load is resistive, find the

(i) firing angle

(ii) RMS output voltage. 5

3. (a) With the help of neat diagram explain the working of a single phase half wave controlled rectifier with RL load and free wheeling diode. 10

(b) What are the advantages of bridge converter over midpoint converter? Obtain the expressions for average and RMS output voltage of a three phase M3 converter with R load for

(i) $\alpha < 30°$

(ii) $\alpha > 30°$ 2+4+4=10

4. (a) What is a chopper? Explain the operating principle of a chopper. 6

(b) What are the different control strategies of a chopper? Explain each. 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. 4

(d) A type-A chopper has input dc voltage of $200V$ and a load of $R = 10\Omega$ in series with $L = 80mH$. If load current varies linearly between $12A$ and $16A$, find the time ratio T_{on}/T_{off} for this chopper. 4

5. *(a)* Give the steady state analysis of a single phase inverter and draw the load voltage and current waveforms for R-load, RL-load and RLC-load. 6+4=10

(b) A single phase full bridge inverter is connected to an RL load. The circuit is initially relaxed. For a dc source voltage of V_s and output frequency $\frac{1}{T}$, obtain expressions for load current as a function of time for the first two half cycles of the output voltage. 6

(c) A single phase half-bridge inverter connected to $230V$ dc source, feeds a resistive load of 10Ω. Determine —

(a) fundamental *rms* output voltage

(b) total output power and fundamental frequency power. 4

6. *(a)* Explain the different modes of operation of a modified McMurray half bridge inverter. 10

(b) What is an UPS ? Explain the working of short break and no break UPS with neat diagram. 10

7. *(a)* What is an SMPS? What are the different configurations of SMPS? Explain *any one* configuration of SMPS. 2+2+6=10

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