53 (IE 602) PWEL

2016

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)* Describe the physics of device operation of Power BJT.

   Also, discuss the switching characteristics of Power BJT.   10

   (b) Differentiate the following :   6

   (i) General diode and Power diode

   (ii) IGBT and MOSFET.

(c) Define the following :   4

   (i) Threshold voltage in MOSFET

   (ii) Holding current in Thyristor.

2. *(a)* Describe the Two-Transistor model of Thyristor and derive an expression for the anode current. Also, discuss the turn on mechanism of Thyristor on the basis of Two-Transistor model.   8

 (b) Draw a circuit diagram illustrating the protection of both anode and gate circuits of a Thyristor. Describe briefly the functions of various components used in the circuit.   6

 (c) Describe in brief the structural feature and operation of an UJT. Draw the circuit diagram of a UJT firing circuit and explain in brief.   6

3. *(a)* Determine the expressions for average value and R-M-S value of output voltage for the following circuits :   10

   (i) Single phase full wave phase controlled rectifier with RL load and freewheeling diode

(ii) Single phase half wave phase controlled rectifier with RL load.

Also, draw the voltage waveforms in each case.

(b) A single phase transformer, with secondary voltage of $220V$, $50Hz$, delivers power to a load $R = 15\Omega$ through a half-wave controlled rectifier circuit. For a firing angle delay of $45°$, determine :

(i) the rectification efficiency

(ii) form factor

(iii) voltage ripple factor

(iv) transformer utilization factor (TUF)

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(c) For a three phase half wave phase controlled rectifier, derive expressions for the average output voltage for firing angle delay of α less than $30°$. Also draw the relevant waveforms.   5

4. *(a)* Explain the basic principle of operation of step up and step down Chopper using suitable diagrams and voltage waveforms. Also, deduce the expression for average output voltage in each case.   10

(b) Describe the basic principle of operation of single phase bridge inverter using a circuit diagram. Determine the expressions for RMS output voltage, instantaneous output voltage and the RMS value of fundamental component. 8

(c) What do you understand by Total Harmonic Distortion (THD) ? Write the expressions for THD in case of single phase inverter. 2

5. *(a)* Describe the basic principle of D.C Motor Control. Discuss method for D.C Motor Control using power devices and drives. 10

(b) Draw the circuit diagram of single phase full wave a.c voltage controller for R load and explain its operation. Also, determine the expressions for R.M.S value of output voltage.

A single phase full wave ac voltage controller has a resistive load of $R = 20\Omega$ and the input voltage is $V_s = 220V$. The delay angles of thyristors are equal to $\pi/2$. Determine :

(i) the RMS output voltage V_0

(ii) the input PF. 10

6. (a) Explain the basic principle of operation of single phase to single phase step down cycloconverter using a suitable circuit diagram. Draw the voltage waveforms. 6

(b) What is SMPS? Using a suitable diagram, describe its working. 7

(c) What is a UPS? Describe short break static and no break static UPS configuration. 7

7. Write short notes on : *(any two)* 20

(a) Classification of chopper

(b) Three phase inverter

(c) Bulk converter.