Visvesvaraya Technological University, Belagavi

MODEL QUESTION PAPER

5th Semester, B.E. (CBCS) EE

Course: 15EE53 – Power Electronics

Time: 3 hours **Max. Marks: 80**

Note: (i) Answer Five full questions selecting any one full question from each Module.

Module-1

1 a. Explain in brief, the different types of power electronic converter circuits and also specify the form of input and output with waveforms. [8]

b. If a single-phase full-wave rectifier with center-tapped transformer has a purely resistive load of R, determine (a) the efficiency, (b) the RF, (c) the TUF and (d) the input power factor PF. [8]

OR

2 a. What is power electronics? Mention its industrial applications. [6]

b. Explain the function of a freewheeling diode, in a switched RL load circuit. Draw the circuit diagram and waveforms. [6]

c. Compare the advantages and disadvantages of bridge rectifier and rectifier with centre-tapped transformer. [4]

Module-2

3 a. Explain the isolation of gate drive using (i) pulse transformers and (ii) optocouplers [8]

b. With the help of waveforms, explain the switching characteristics of a BJT. [8]

OR

4 a. Draw the circuit diagram for an IGBT and explain its typical output characteristics. [8]

b. The bipolar transistor is specified to have β_F in the range of 8 to 40. The load resistance is $R_C = 15\ \Omega$. The dc supply voltage is $V_{CC} = 150$ V and the input voltage to the base circuit is $V_B = 8$ V. If $V_{CE\,(sat)} = 1.0$ V, $V_{BE(sat)} = 1.5$ V and $R_B = 1.047\ \Omega$, determine (a) the ODF, (b) the forced β and (c) the power loss in the transistor P_T. [8]

Module-3

5 a. With a neat sketch describe the two-transistor model of a thyristor and obtain the expression for anode current. [8]

b. Ten thyristors are used in a string to withstand a dc voltage of $V_S = 15$ kV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150μC, respectively. Each thyristor has a voltage-sharing resistance of $R = 56$ kΩ and capacitance of $C_1 = 0.5$μF. Determine (a) the maximum steady-state voltage sharing $V_{DS(max)}$, (b) the steady-state voltage derating factor, (c) the maximum transient voltage sharing $V_{DT(max)}$, and (d) the transient voltage derating factor. [8]

OR

6 a. Explain the VI characteristics of SCR with a neat graph. [6]

b. Briefly explain the following:

(i)LASCR (ii) GTO (iii) TRIAC

[6]

C. A thyristor carries a current as shown in Figure 6 (b). The switching frequency is f_s =120 Hz. Determine the average ON state current I_T.

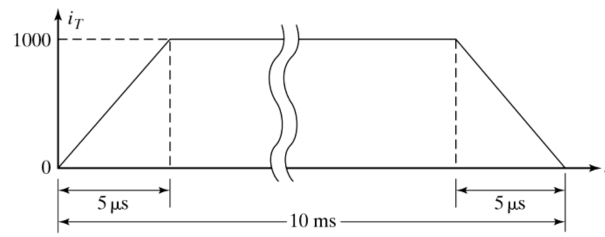

Fig 6 (b) [4]

Module-4

7 a. With the help of suitable diagrams, explain the working of a single phase dual converter. [8]

b. A single-phase ac voltage controller in Figure 7 (b) has a resistive load of $R = 10\ \Omega$ and the rms input voltage is $V_s = 120$ V, 60 Hz. The delay angle of thyristor $T1$ is $\alpha = \pi/2$. Determine (a) the rms value of output voltage V_o, (b) the input PF, and (c) the rms input current I_s.

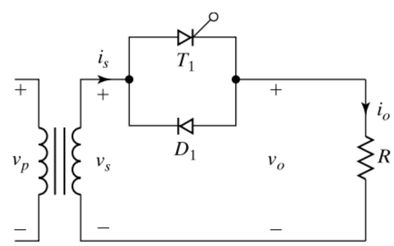

Fig. 7 (b) [8]

OR

8 a. Draw the circuit diagram of a three phase bidirectional controller for a resistive load and show the waveforms for (a) Input line voltages, (b) Input phase voltages, (c) Thyristor gate pulses, and (d) Output phase voltage at a firing angle of 60° [8]

b. A three-phase full-wave converter is operated from a three-phase Y-connected 208-V, 60-Hz supply and the load resistance is $R = 10\ \Omega$. If it is required to obtain an average output voltage of 50% of the maximum possible output voltage, calculate (a) the delay angle α, (b) the rms and average output currents, (c) the rms and average thyristor currents, (d) the rectification efficiency. [8]

Module-5

9 a. Explain the principle of step-up chopper and derive an expression for the average output voltage. [8]

b. The single-phase full-bridge inverter has a resistive load of $R = 2.4\ \Omega$ and the dc input voltage is $V_s = 48$ V. Determine (a) the rms output voltage at the fundamental frequency, and (b) the output power P_o. [4]

c. What are the main differences between voltage-source and current-source inverters? [4]

OR

10 a. Draw the circuit diagram for a four quadrant converter and explain its working [6]

b. Explain 120° conduction mode of operation in a three-phase inverter along with circuit and neat waveforms. [10]

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