CBCS SCHEME

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15EC73

Seventh Semester B.E. Degree Examination, July/August 2022
Power Electronics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain five different types of power electronics converter circuits with their input and output wave forms. **(10 Marks)**

b. A BJT switch has β in the range of 8 to 40, calculate (i) The value of R_B that will result in saturation with an overdrive factor of 5 (ii) The forced beta β_f and the power loss in the transistor. $V_{CC} = 200$ V, $V_{bb} = 10$ V, $V_{be(sat)} = 1.5$ V, $V_{ce(sat)} = 1$ V, $R_C = 10\ \Omega$. **(06 Marks)**

OR

2 a. Explain any five power electronics devices with VI characteristics and their symbols. **(10 Marks)**

b. An IGBT switch has $t_{ON} = 3$ μsec, $t_{OFF} = 1.2$ μsec, duty cycle D = 0.7, $V_{CE(sat)} = 2$ V, $f_s = 1$ kHz. Determine
- (i) Average load current.
- (ii) Conduction power loss.
- (iii) Switching power loss during turn on and turn off. **(06 Marks)**

Module-2

3 a. With two transistor analogy, explain the working of a Thyristor and obtain the equation for anode current. **(08 Marks)**

b. Distinguish between holding current and latching current of a Thyristor. **(02 Marks)**

c. A SCR circuit operates from 300 V DC supply has series inductance of 4 μH. A resistance of 4 Ω and capacitance of 0.2 μF is connected across the SCR. Calculate the safe $\frac{dv}{dt}$ and $\frac{di}{dt}$ ratings of SCR. **(06 Marks)**

OR

4 a. With necessary circuit diagram and waveforms explain the resonant pulse commutation. **(08 Marks)**

b. The resonant pulse commutation circuit has a capacitance of C = 30 μF and $L = 4\ \mu H$. The initial capacitor voltage is $V_0 = 200$ V. Determine the circuit turn-off time for the load current $I_m = 250$ A. **(08 Marks)**

Module-3

5 a. With neat circuit diagrams and suitable waveforms explain the working of a single phase dual converter. **(06 Marks)**

b. Derive an expression for RMS output voltage of a single phase full controller having inductive load for discontinuous load current. Draw the relevant wave forms. **(06 Marks)**

c. A single phase full wave ACVC has a resistive load of R = 10 Ω and the input voltage is $V_S = 200$ V rms/ 60 Hz. The firing angles of T_1 and T_2 are $\alpha_1 = \alpha_2 = \frac{\pi}{2}$. Determine (i) RMS output voltage V_0 (ii) Input PF (iii) The average current of thyristors I_a. (iv) The rms current of the thyristor. **(04 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

6 a. With the help of neat circuit diagram and wave forms explain the operation of single phase full wave bidirectional controller using diode bridge and single SCR with R load. Derive the equation for V_O(RMS). **(10 Marks)**

b. Obtain an expression for RMS value of load voltage in on-off A.C. voltage controller. For a 230 V/50 Hz ON-OFF controller ON time is 10 cycles and off time is 4 cycles. Calculate $V_{0(RMS)}$ output voltage. **(06 Marks)**

Module-4

7 a. Explain the working of step-down choppers with necessary circuit diagram and waveforms. Derive the equation for $V_{O(av)}$ and V_{ORMS}. **(06 Marks)**

b. Give the classification of chopper. Explain briefly each one of them. **(10 Marks)**

OR

8 a. With the help of circuit diagram and waveforms, explain the operation of step-up chopper. **(06 Marks)**

b. With a neat circuit diagram and wave forms explain the working principle of Buck regulator. Derive the expression for peak to peak ripple voltage of the capacitor, present across the load. **(10 Marks)**

Module-5

9 a. With circuit diagram and waveforms explain the working of a single phase full bridge inverter with RL load. **(10 Marks)**

b. With neat circuit diagram, explain the variable DC link inverter. **(06 Marks)**

OR

10 a. With neat circuit diagram, explain the working of a transistorized current source inverter. **(06 Marks)**

b. Explain the working of a solid state relay with suitable diagram. **(06 Marks)**

c. Considering a single phase bridge inverter, if the DC voltage is 200 V and the required RMS fundamental output voltage is 90 V, determine the delay angle β. **(04 Marks)**

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