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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  $\beta$  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  $\beta_f$  and the power loss in the transistor.  $V_{CC} = 200 \text{ V}$ ,  $V_{bb} = 10 \text{ V}$ ,  $V_{be(sat)} = 1.5 \text{ V}$ ,  $V_{ce(sat)} = 1 \text{ V}$ ,  $R_C = 10 \Omega$ . (06 Marks)

**OR**

- 2 a. Explain any five power electronics devices with VI characteristics and their symbols. (10 Marks)
- b. An IGBT switch has  $t_{ON} = 3 \mu\text{sec}$ ,  $t_{OFF} = 1.2 \mu\text{sec}$ , duty cycle  $D = 0.7$ ,  $V_{CE(sat)} = 2 \text{ V}$ ,  $f_s = 1 \text{ kHz}$ . 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  $4 \mu\text{H}$ . A resistance of  $4 \Omega$  and capacitance of  $0.2 \mu\text{F}$  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  $C = 30 \mu\text{F}$  and  $L = 4 \mu\text{H}$ . The initial capacitor voltage is  $V_0 = 200 \text{ V}$ . Determine the circuit turn-off time for the load current  $I_m = 250 \text{ A}$ . (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  $R = 10 \Omega$  and the input voltage is  $V_s = 200 \text{ V rms/ 60 Hz}$ . 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)

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  $V_{O(RMS)}$  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  $\beta$ . (04 Marks)

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