

USN

--	--	--	--	--	--	--	--

17EC73

Seventh Semester B.E. Degree Examination, June/July 2024

Power Electronics

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Draw the symbols and the V-I characteristics of the following power semiconductor devices: (i) Diode (ii) Thyristor (SCR) (iii) SITH (iv) GTO (v) TRIAC (10 Marks)
- b. Explain peripheral effects of power electronic components and equipment, mention how to eliminate them. (06 Marks)
- c. List out different applications of power electronic system. (04 Marks)

OR

- 2 a. Explain the important characteristic features of power transistors and discuss different operating ranges of power BJT with the aid of output and transfer characteristic. (10 Marks)
- b. Illustrate the switching characteristics of power MOSFET with necessary waveforms. (10 Marks)

Module-2

- 3 a. Explain the two transistor model of SCR and also derive the expression for anode current of SCR with gate current. (08 Marks)
- b. The latching current of Thyristor shown in Fig.Q3 (b) is 50 mA. The Duration of firing pulse is 50 μ s. Will the Thyristor get fired? (04 Marks)

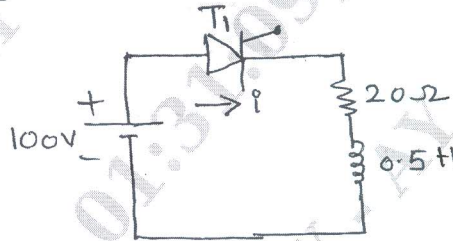


Fig. Q3 (b)

- c. Explain the various turn on methods of SCR. (08 Marks)

OR

- 4 a. With a neat circuit and associated waveforms explain the operation of class B self commutation. (08 Marks)
- b. Explain the operation of Resistance Capacitance (RC) fullwave trigger circuit with a neat circuit and waveforms. (06 Marks)
- c. Design a UJT relaxation oscillator for triggering an SCR. The UJT has the following parameters:

$$\eta = 0.7, I_P = 50 \mu\text{A}, V_V = 2 \text{ V}, I_V = 6 \text{ mA}, V_{BB} = 20 \text{ V}, R_{BB} = 7 \text{ K}\Omega$$

The leakage current with emitter open is 2 mA. The triggering frequency is 1 kHz and $V_{g(\text{min})} = 0.2 \text{ V}$. Assume $C = 0.1 \mu\text{F}$. (06 Marks)

Module-3

- 5 a. Describe with neat diagram and waveforms, half wave controlled rectifier with freewheeling diode and obtain average value of output voltage. (12 Marks)

- b. A single phase full converter is operated from 120 V, 60 Hz supply. The load current with an average value of I_a is continuous with negligible ripple current. If turn ON ratio of transformer is unity with delay angle $\alpha = \frac{\pi}{3}$. Calculate:
- Harmonic Factor (HF) of input current
 - Displacement Factor (DF)
 - Supply Power Factor (PF)
- (08 Marks)

OR

- 6 a. Illustrate with neat circuit diagram and waveforms, the working principle of single phase AC voltage controller using phase control. Obtain average value of output voltage for single phase half wave controller. (12 Marks)
- b. A single phase half wave AC voltage controller has resistance load of $R = 5\Omega$ and input voltage $V_s = 120$ V, 60 Hz. The delay angle of thyristor is $\alpha = \frac{\pi}{3}$, determine:
- rms output voltage
 - input power factor
 - average input current
- (08 Marks)

Module-4

- 7 a. Explain the working principle of step down chopper with resistive load. With neat circuit and associated waveforms. Derive the equation for, (i) rms output voltage (ii) Effective input resistance in terms of chopper duty cycle. (08 Marks)
- b. Classify the chopper and explain each classification in brief with circuit diagrams. (08 Marks)
- c. Explain the performance parameters of choppers. (04 Marks)

OR

- 8 a. With a neat circuit and waveforms explain the working of Buck regulator. (10 Marks)
- b. A boost regulator shown in Fig. Q8 (b) has an input voltage of $V_s = 5$ V. The average output voltage $V_a = 15$ V and the average load current $I_a = 0.5$ A. The switching frequency is 25 kHz. If $L = 150 \mu\text{H}$ and $C = 220 \mu\text{F}$. Determine
- The duty cycle K .
 - The ripple current of inductor ΔI .
 - The ripple voltage of filter capacitor ΔV_c .
 - The critical values of L and C .

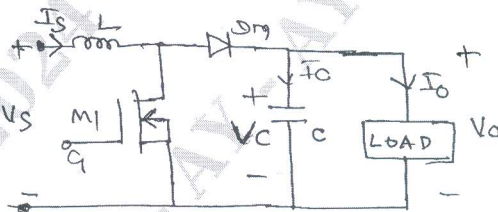


Fig. Q8 (b)

(10 Marks)

Module-5

- 9 a. Explain the performance parameters of inverters. (08 Marks)
- b. Give the comparison between Current Source Inverter (CSI) and Voltage Source Inverter (VSI). (04 Marks)
- c. With circuit diagram, explain single phase bridge inverter. (08 Marks)

OR

- 10 a. Write short notes on
- Single phase AC switches
 - Solid state Relays
- (10 Marks)
- b. Explain the working of variable dc-link inverter. (10 Marks)