CBCS SCHEME

USN | | | | | | | | | | |

17EC73

Seventh Semester B.E. Degree Examination, July/August 2021
Power Electronics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Explain with a neat circuit and waveforms different types of power converters. **(10 Marks)**

b. What are the peripheral effects of power electronic circuits? What are the remedies for them? **(06 Marks)**

c. With circuit diagram, explain the control characteristics of, (i) SCR (ii) MOSFET **(04 Marks)**

2 a. Draw the switching model of MOSFET and explain its switching characteristics. **(08 Marks)**

b. The bipolar transistor is shown in Fig. Q2 (b) is specified to have β_F in the range of 8 to 40. The load resistance is $R_C = 11\Omega$. The DC supply voltage is V_{CC} = 200 V and the input voltage to the base circuit is V_B = 10 V. If $V_{CE(Sat)} = 1.0$ V and $V_{BE(Sat)} = 1.5$ V, find

(i) The value of R_B that results in saturation with an over drive factor of 5.
(ii) The forced value of β.
(iii) The power loss P_T in the transistor. **(08 Marks)**

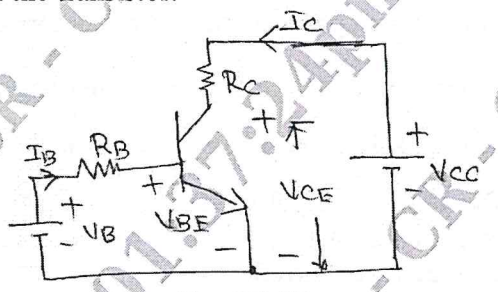

Fig. Q2 (b)

c. Explain the output characteristics of IGBT. **(04 Marks)**

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 μs. Will the Thyristor get fired? **(04 Marks)**

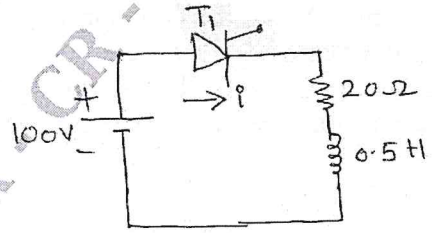

Fig. Q3 (b)

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

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:
$\eta = 0.7$, $I_P = 50\ \mu A$, $V_V = 2\ V$, $I_V = 6\ mA$, $V_{BB} = 20\ V$, $R_{BB} = 7\ K\Omega$
The leakage current with emitter open is 2 mA. The triggering frequency is 1 kHz and $V_{g(min)} = 0.2V$. Assume $C = 0.1\ \mu F$. **(06 Marks)**

5 a. With a neat circuit, associated waveforms explain the operation of a single phase full converter and show that the converter can operates in two quadrants by deriving the relevant expression. Assume highly inductive load with ripple free continuous load current. **(08 Marks)**

b. A single phase half-wave controlled converter is operated from 120 V, 50 Hz supply. Load resistance R = 10 Ω. If average output voltage is 25% of the maximum possible average output voltage determine (i) Firing angle (ii) Average and rms values of SCR currents. **(06 Marks)**

c. Explain the operation of a single phase dual converter with circulating current mode with a neat circuit diagram and waveforms. **(06 Marks)**

6 a. Compare on-off control with phase angle control as applied to AC voltage controllers. **(04 Marks)**

b. A single phase unidirectional AC voltage controller has a resistive load of R = 10 Ω and the input voltage is 120 V, 50 Hz. The delay angle of the thyristor is $\alpha = \frac{\pi}{2}$. Determine

(i) The rms value of output voltage V_0.
(ii) The input power factor.
(iii) The average input current.
(iv) The average output current. **(08 Marks)**

c. With neat circuit diagram and waveforms, explain the operation of single phase bidirectional AC voltage controller for resistive load. Derive the equation for rms output voltage. **(08 Marks)**

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)**

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 μH and C = 220 μF. Determine

(i) The duty cycle K.

(ii) The ripple current of inductor ΔI.

(iii) The ripple voltage of filter capacitor ΔV_C.

(iv) The critical values of L and C. **(10 Marks)**

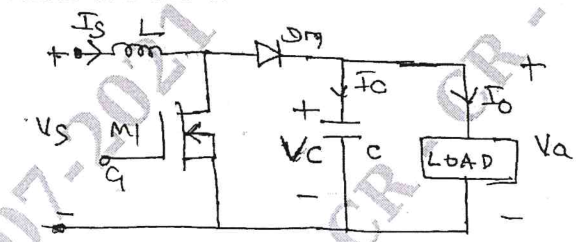

Fig. Q8 (b)

9 a. What do you mean by Inverter? Explain the operation of single phase half bridge inverter, with neat circuit and waveforms. **(08 Marks)**

b. The single phase full bridge inverter has a resistive load of R = 2.4 Ω and the dc input voltage is $V_S = 48$ V. Determine

(i) The rms output voltage at the fundamental frequency V_{01}.

(ii) The output power P_0.

(iii) The average and peak currents of each transistor.

(iv) The peak reverse blocking voltage V_{BR} of each transistor. **(06 Marks)**

c. Explain the performance parameters of inverter. **(06 Marks)**

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

b. Explain single phase AC switches. **(07 Marks)**

c. Explain solid state relays. **(07 Marks)**

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