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10EC73

Seventh Semester B.E. Degree Examination, Aug./Sept.2020

Power Electronics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What is power electronics? Give two applications of power electronics. **(03 Marks)**

b. Explain the control characteristic of the following power devices:
(i) SCR (ii) TRIAC (iii) MCT (iv) SITH **(08 Marks)**

c. Explain briefly the different types of thyristor power converters and mention two applications of each. **(09 Marks)**

2 a. With necessary waveforms, explain the switching characteristics of a power transistor. **(08 Marks)**

b. Give the comparison between BJT, MOSFET and IGBT. **(06 Marks)**

c. The beta (β) of bipolar transistor is shown in Fig.Q2(c) below varies from 12 to 75. The load resistance $R_c = 1.5\Omega$. The dc supply voltage is $V_{CC} = 40$ V and input voltage to the base circuit $V_B = 6V$ if $V_{CE(sat)} = 1.2V$, $V_{BE(sat)} = 1.6V$, $R_B = 0.7\Omega$. Determine:
(i) Overdrive factor (ODF)
(ii) The forced beta
(iii) The power loss in the transistor P_T

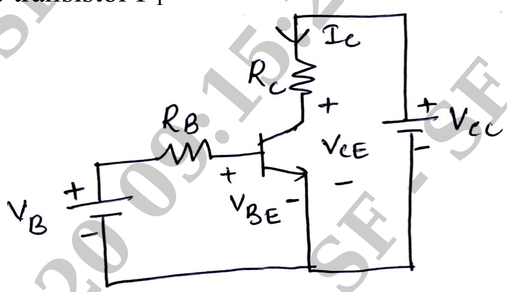

Fig.Q2(c) **(06 Marks)**

3 a. Explain the turn on mechanism of a thyristor using two transistor analogy and derive an expression for the anode current interms of transistor parameters. **(08 Marks)**

b. What is the need for protection of thyristors? Explain how thyristors are protected against high $\frac{di}{dt}$ and high $\frac{dv}{dt}$? **(06 Marks)**

c. With relevant circuit diagram and waveforms, explain the UJT firing circuit. **(06 Marks)**

4 a. With a neat diagram and waveform, explain the principle of single phase full converts with purely resistive load. Derive the expression for RMS output voltage and average output voltage. **(10 Marks)**

b. Compare circulating and non-circulating mode of operation of dual converter. **(04 Marks)**

c. How do you classify phase controlled converters? Explain. **(06 Marks)**

PART – B

5 a. Explain the operation of impulse commutation with the relevant circuit diagram and waveforms. **(08 Marks)**

b. In the circuit of Fig.Q5(b), the capacitor is initially charged to a voltage of $V_C(0) = 500$ V. If $L = 15$ μH and $C = 50$ μF and SCR is turned ON at $t = 0$. Calculate: (i) The peak value of resonant current (ii) The conduction type of thyristor

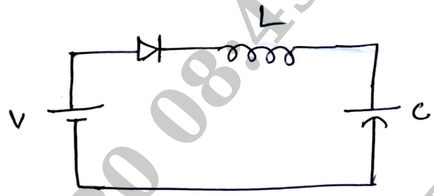

Fig.Q5(b) **(07 Marks)**

c. State the conditions under which a load carrying thyristor can be successfully commutated. **(05 Marks)**

6 a. Draw the circuit diagram of a single phase AC voltage controller and explain the principle of ON-OFF control, with the help of relevant waveforms. Derive the expression for RMS output voltage in terms of RMS supply voltage and duty cycle of the operation of the controller? **(10 Marks)**

b. An AC voltage controller in Fig.Q6(b) has a resistive load of $R = 10\Omega$ and the RMS input voltage is $V_S = 120$V, 60Hz. The thyristor switch is ON for $n = 25$ cycles and is off for $m = 75$ cycles. Determine:
(i) The output voltage, V_0
(ii) The input power factor (PF)
(iii) The average and RMS current of thyristors.

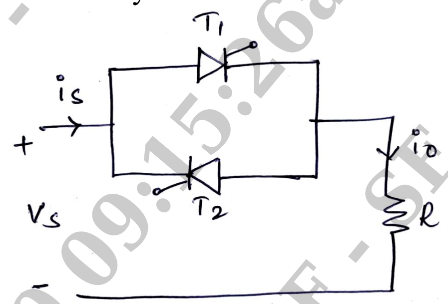

Fig.Q6(b) **(07 Marks)**

c. Distinguish between ON-OFF control and phase control. **(03 Marks)**

7 a. Explain the principle of operation of a step up chopper with suitable circuit diagram and waveforms. Derive the expression for average output voltage of step up chopper. **(10 Marks)**

b. Explain how choppers are classified. **(06 Marks)**

c. A DC chopper has an input voltage of 20V and a load of 8Ω resistance. The voltage drop across thyristor is 2V and the chopper frequency is 800 Hz. The duty cycle $K = 0.4$. Find:
(i) Average output voltage (ii) RMS output voltage (iii) Chopper efficiency **(04 Marks)**

8 a. Explain the performance parameters of inverters. **(06 Marks)**

b. A single phase full bridge inverter has a resistive load of 2.4 Ω and the DC input voltage 48V. Determine:
(i) RMS output voltage at the fundamental frequency
(ii) Output power. **(04 Marks)**

c. Explain the working of transistorized current source inverter. **(10 Marks)**

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