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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 $V_{CC} = 40\text{ V}$ and input voltage to the base circuit $V_B = 6\text{V}$ if $V_{CE(sat)} = 1.2\text{V}$, $V_{BE(sat)} = 1.6\text{V}$, $R_B = 0.7\Omega$. Determine:
 (i) Overdrive factor (ODF)
 (ii) The forced beta
 (iii) The power loss in the transistor P_T

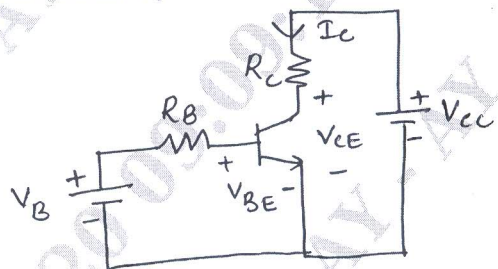


Fig.Q2(c)

(06 Marks)

- 3 a. Explain the turn on mechanism of a thyristor using two transistor analogy and derive an expression for the anode current in terms 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 converters 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)

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.

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

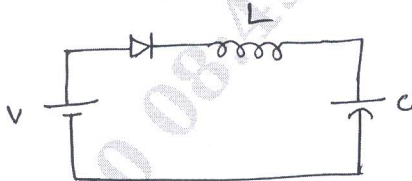


Fig.Q5(b)

(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 $V_S = 120\text{V}$, 60Hz. The thyristor switch is ON for $n = 25$ cycles and is off for $m = 75$ cycles. Determine:
- The output voltage, V_0
 - The input power factor (PF)
 - The average and RMS current of thyristors.

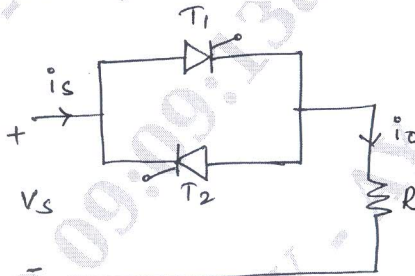


Fig.Q6(b)

(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:
- Average output voltage
 - RMS output voltage
 - 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 2.4Ω and the DC input voltage 48V. Determine:
- RMS output voltage at the fundamental frequency
 - Output power.
- (04 Marks)
- c. Explain the working of transistorized current source inverter. (10 Marks)
