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06EC73

Seventh Semester B.E. Degree Examination, June/July 2011
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. Give the definition of power electronics. Explain the relationship of power electronics to power, electronics and control. Mention any two applications of PE. **(06 Marks)**

b. With the circuit diagram, input and output waveforms, explain the control characteristics of SCR and IGBT. **(06 Marks)**

c. Explain any four different types of power converter circuits with the circuit, input and output waveforms. Also, mention one application of each type. **(08 Marks)**

2 a. What is the necessity of base drive control in a power transistor? Explain proportional base control. **(08 Marks)**

b. A transistor switch of Fig.Q2(b) has β in the range of 8 to 40. Calculate i) the value of R_B that results in saturation, with an overdrive factor of 5. ii) The forced β_f and iii) The power loss in the transistor. **(06 Marks)**

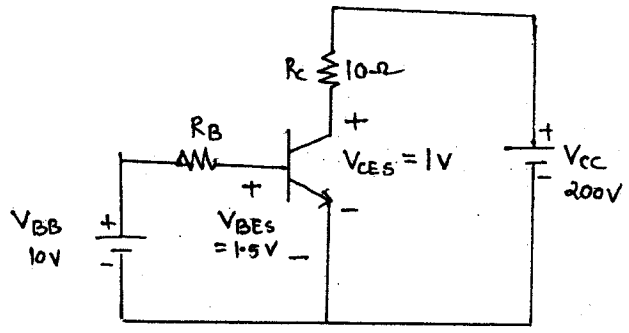

Fig.Q2(b)

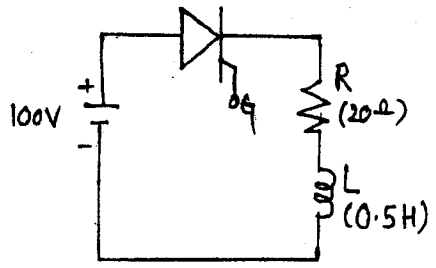

Fig.Q3(c)

c. With necessary sketches, explain briefly the switching characteristics of an IGBT. **(06 Marks)**

3 a. Sketch the gate characteristics of an SCR and explain the different regions of gate characteristics. Also indicate different regions, different voltages and different currents on the gate characteristics. **(10 Marks)**

b. With a neat circuit diagram and waveforms, explain the resistor triggering circuit. **(06 Marks)**

c. The latching current of a thyristor shown in Fig.Q3(c) is 50 mA. The duration of gate pulse is 50 μsec. Will the thyristor get fired? **(04 Marks)**

4 a. With a neat circuit diagram and waveforms, explain the working of a single phase full converter feeding highly inductive load. Derive the expression for the average output voltage and rms output voltage. **(10 Marks)**

b. Give the equations to show that the power factor of semiconverter is better than that of full converter. **(04 Marks)**

c. Design UJT relaxation oscillator for triggering of thyristor. The UJT has the following parameters $\eta = 0.7$, $I_P = 50\ \mu A$, $V_V = 2V$, $I_V = 6$ mA, $V_{BB} = 20V$, $R_{BB} = 7\ k\Omega$, $I_{EO} = 2$ mA. Also determine the limits for the output frequency of the oscillator. Assume $V_{g(min)} = 0.2V$. **(06 Marks)**

PART – A

5 a. With a neat circuit diagram and waveforms, explain the auxiliary commutation. **(10 Marks)**

b. For the complementary commutation circuit show in Fig.Q5(b), calculate the values of C to provide circuit turn off time of 20 μsec. **(06 Marks)**

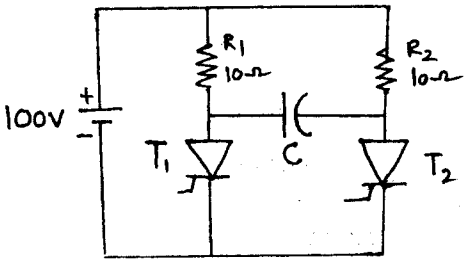

Fig.Q5(b)

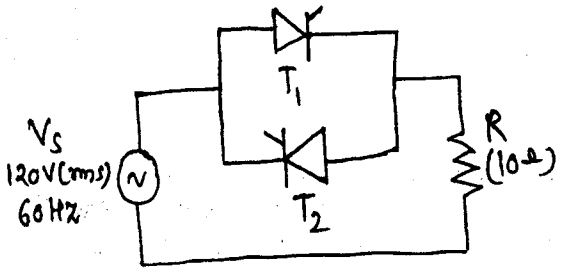

Fig.Q6(c)

c. State the conditions under which load carrying thyristor can be successfully commutated. **(04 Marks)**

6 a. With a necessary waveforms, explain the operation of a single phase full wave controller with inductive load. Derive the expression for rms output voltage. **(08 Marks)**

b. What is an ac voltage controller? With the help of circuit diagram and waveform, explain the principle of phase control. **(06 Marks)**

c. A 1ϕ full wave ACVC has a resistive load of R = 10 Ω as shown in Fig.Q6(c). The input is V_S = 120 V(rms), 60 Hz. The delay angle of thyristors T_1 and T_2 are equal to $\alpha_1 = \alpha_2 = \pi/2$. Calculate i) rms output voltage ii) the average current through thyristors I_A iii) rms current of thyristors I_R iv) the input P.F. **(06 Marks)**

7 a. Explain the different control strategies used in choppers. **(06 Marks)**

b. With a neat circuit diagram and waveforms, explain the operation of Jones chopper. **(10 Marks)**

c. In the chopper circuit shown in Fig.Q7(c), the average output voltage is 109 V. The voltage drop across chopper switch when it is ON is V_S = 2 V. The load resistor R = 10Ω, f =1.5 kHz and duty cycle ratio δ = 50%. Calculate the i) dc input voltage to the chopper ii) rms output voltage. **(04 Marks)**

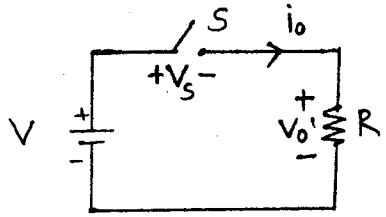

Fig.Q7(c)

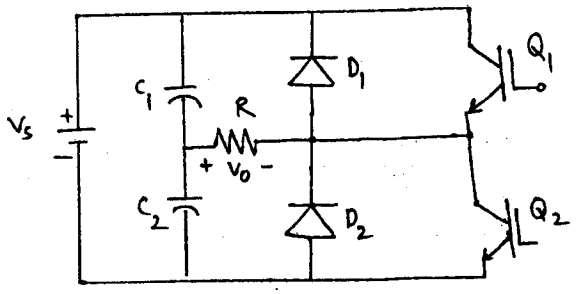

Fig.Q8(c)

8 a. With necessary sketches, explain the single phase transistorized current source inverter. **(08 Marks)**

b. With necessary waveforms, explain the single pulse width modulation technique of varying the magnitude of output voltage in a single-phase inverter. **(06 Marks)**

c. The single phase bridge inverter in Fig.Q8(c) has a resistive load of R = 2.4Ω and the dc input voltage is V_S = 48V. Calculate i) the rms output voltage at the fundamental frequency V_{01} ii) the output power iii) the average and peak currents of each transistor iv) the peak reverse blocking voltage V_{BR} of each transistor v) the THD vi) D.F. **(06 Marks)**

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