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Fourth Semester B.E. Degree Examination, December 2010 Power Electronics

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions.
2. Missing data may be suitably assumed.**

1.
 - a. Give the circuit symbol, V-I characteristics and applications of various semiconductor devices. (08 Marks)
 - b. Mention and explain the various types of power electronic converters. (06 Marks)
 - c. With the help of necessary waveforms, explain the switching characteristics of a transistor. (06 Marks)

2.
 - a. Give the constructional details and switching characteristics of a power MOSFET. (07 Marks)
 - b. What is the need of base drive control? Explain the proportional control and anti-saturation control. (07 Marks)
 - c. The bipolar transistor is to have a range of β from 8 to 40. The load resistance $R_C = 11 \Omega$. The d.c. supply voltage $V_{CC} = 200 \text{ V}$ and the input voltage to the base circuit is $V_B = 10 \text{ V}$. If $V_{CE(sat)} = 1.5 \text{ V}$, find
 - i) R_B that results in saturation with an override factor of 5m
 - ii) Forced B_f .
 - iii) Power loss in the transistor.
 Refer Fig. Q2 (c). (06 Marks)

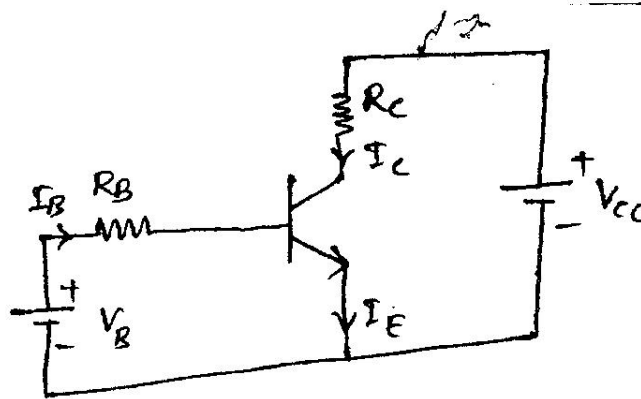


Fig. Q2 (c)

3.
 - a. Explain the static V-I characteristics of an SCR. (06 Marks)
 - b. Mention and explain the various methods of turn ON of an SCR. (08 Marks)
 - c. SCRs with ratings of 1000 V and 20 A are available, to be used in a string, to handle 6 KV and 1 KA. Calculate the number of series and parallel units required, in case the derating factor is i) 0.1 and ii) 0.2. (06 Marks)

4.
 - a. What do you mean by commutation? Explain the line commutation and load commutation. (07 Marks)
 - b. With the help of a circuit diagram and waveforms, explain the operation of complementary commutation. (07 Marks)

- 4 c. The resonant pulse commutation circuit shown in figure Q4 (c) has a capacitance $C = 30 \mu\text{H}$ and inductance $L = 4 \mu\text{H}$. The initial capacitor voltage $V_0 = 200 \text{ V}$. Determine the circuit turn-off time t_{off} if the load current $I_m = 250 \text{ A}$. (06 Marks)

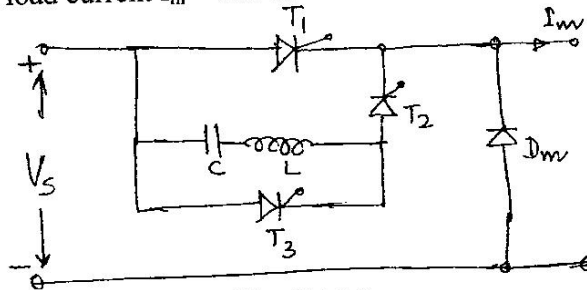


Fig. Q4 (c)

- 5 a. With the necessary circuit and waveforms, explain the operation of a single phase voltage controller, feeding an R-L load. (08 Marks)
- b. Explain why a short pulse is not sufficient to trigger the thyristor, in case of a single phase AC voltage controller, with RL load. (05 Marks)
- c. A single phase voltage controller has input voltage of 230 V, a frequency 50 Hz and a load of $R = 15 \Omega$. For 6 cycles ON and 4 cycles OFF, determine, i) RMS output voltage ii) Input power factor iii) Average and RMS thyristor current. (07 Marks)
- 6 a. Mention the applications of converters. Explain the principle of operation of a single phase half wave rectifier with R-L load involving free wheeling diode. (07 Marks)
- b. With the necessary circuit diagram and waveforms, explain the principle of operation of a single phase dual converter. (07 Marks)
- c. A single phase full converter, operating from a 230 V, 50 Hz supply, has a pure resistive load of $R = 15 \Omega$. If the average load current is 11.78 A, calculate, i) Delay angle α ii) RMS output voltage and current iii) Average and RMS thyristor current. (06 Marks)
- 7 a. With the help of circuit diagram and their operating characteristics, explain the various types of chopper circuit configurations. (08 Marks)
- b. With the help of the basic circuit, explain the operation of step up chopper. Discuss the methods of duty cycle control. (08 Marks)
- c. A step down chopper is operating from a 220 V d.c. source. The load has $R = 5 \Omega$ and a very large inductance, so that load current may be assumed to be constant at 22 A. If the chopper frequency is 250 Hz, calculate the ON and OFF period and duty cycle of the chopper. (04 Marks)
- 8 a. Give the comparison between single phase half bridge and full bridge inverter. (08 Marks)
- b. With the help of necessary circuit and waveforms, explain the operation of a 3-phase inverter, operating in 180° mode operation. (07 Marks)
- c. For a single phase full-bridge inverter, $V_S = 230 \text{ V}$, $T = 1 \text{ ms}$. The load consists of RLC in series with $R = 1 \Omega$, $\omega L = 6 \Omega$ and $\frac{1}{\omega C} = 7 \Omega$. (i) Sketch the waveforms for load voltage V_o , fundamental component of load current i_{o1} and the voltage across the thyristor. (05 Marks)
