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06EE45

Fourth Semester B.E. Degree Examination, June/July 08
Power Electronics

Time: 3 hrs. Max. Marks:100

Note : *Answer any FIVE questions choosing at least TWO questions from each part.*

Part A

1 a. List the different types of power electronic circuits and converter circuits and their applications. **(06 Marks)**

b. Plot the input and output characteristics of any four power semiconductor devices. **(08 Marks)**

c. What are the advantages of static power converters? Mention the peripheral effects of such static power converters. **(06 Marks)**

2 a. Explain how antisaturation base control improves the switching performance of a BJT. **(06 Marks)**

b. With the help of switching waveforms explain the switching times of a power MOSFET. **(07 Marks)**

c. A transistor switch of figure Q2 (c) 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 BJT. **(07 Marks)**

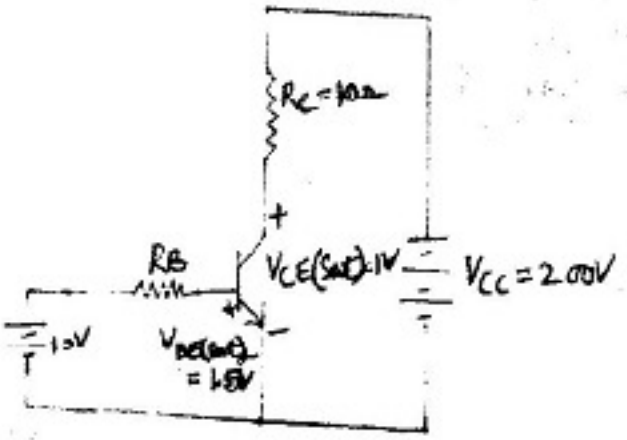

Fig. Q2 (c)

3 a. Explain the principle of operation of an SCR using two transistor model. **(06 Marks)**

b. What is the need for protection of thyristors? Explain how thyristors are protected against high $\frac{di}{dt}$ and high $\frac{dv}{dt}$. **(07 Marks)**

c. Sketch the static V-I characteristics of an SCR and explain i) Latching current ii) Holding current and iii) Break over voltage. **(07 Marks)**

4 a. Discuss the process of thyristor commutation and differentiate between i) Natural and forced commutation. ii) Self and impulse commutation. **(12 Marks)**

b. The resonant pulse commutation circuit has a capacitance C = 30 μF and L = 4 μH. The initial capacitor voltage is $V_0 = 200V$. Determine the circuit turn off time for the load current $I_L = 250A$. **(08 Marks)**

Part B

5 a. With a circuit diagram and waveforms of gating pulses and output voltage, explain the operation of 1-ϕ ON-OFF type ac voltage controller. Derive an expression for $V_{0(rms)}$. **(10 Marks)**

b. With necessary waveforms explain the operation of 1-ϕ full wave controller with inductive load. Derive expressions for rms output voltage and rms output current. **(10 Marks)**

6 a. Explain the working of 1-ϕ semi converter with the help of waveforms for resistive load and inductive loads. **(10 Marks)**

b. With circuit diagram, explain the operation of a 3ϕ full converter for constant load current. If the input to this circuit is 3ϕ, 50 Hz, ac supply, determine the firing angle, α, for the SCRS to obtain an output average dc voltage of 50% of the maximum. If this output voltage is 270 volts, calculate ac supply line to line rms voltage. **(10 Marks)**

7 a. Explain in detail how choppers are classified. **(10 Marks)**

b. A chopper is feeding an R-L load as shown in the figure Q7 (b), $V_s = 220V$, $R = 5\Omega$, $L = 7.5$ mH, $f = 1$ kHz, $\delta = 0.5$ and $E = 0$ volts. Calculate

i) Minimum instantaneous load current, I_{min}
ii) Peek instantaneous load current I_{max}.
iii) Maximum peek to peek load ripple current.
iv) Average value of load current.
v) rms load current $I_{o(rms)}$.
vi) Effective input resistance R_i.
vii) rms chopper current, $I_{T(rms)}$. **(10 Marks)**

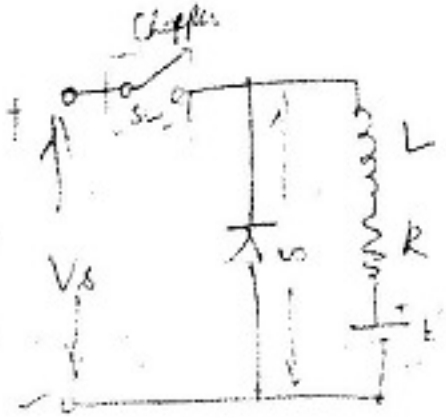

Fig. Q7 (b)

8 a. With necessary waveforms explain the operation of a single phase half bridge inverter. **(10 Marks)**

b. Draw the circuit diagram of a three phase bridge inverter with Y connected resistive load. Sketch the gating signals and line to line output voltages for 180° conduction operation. **(10 Marks)**