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Fourth Semester B.E. Degree Examination, July/August 2004
BM/EC/EE/TE/ML/IT
Power Electronics

Time: 3 hrs.]

[Max.Marks : 100

Note: 1) Answer any FIVE full questions.
 2) All questions carry equal marks

1. (a) With circuit diagrams and waveforms of control signal and output voltage, explain the control characteristics of S.C.R and MOSFET. (8 Marks)
- (b) List the major types of power electronic circuits and mention in each case, the type of input supply given and the output we get. (6 Marks)
- (c) Sketch the output characteristics of enhancement type MOSFET. What are the basic differences in control of BJT and MOSFET? (6 Marks)
2. (a) With a circuit diagram, explain 'antisaturation control' of BJT. Mention the improvement and drawback of this arrangement. (6 Marks)
- (b) Discuss methods for providing isolation of gate/ base circuits from power circuit, with circuit diagrams. (8 Marks)
- (c) For the transistor switch of Fig. Qn. 2c,
 - i) Calculate forced beta, β_f of transistor
 - ii) If the manufacturer's specified β is in the range 8 to 40, calculate the minimum overdrive factor (ODF).
 - iii) Obtain power loss P_T in the transistor.

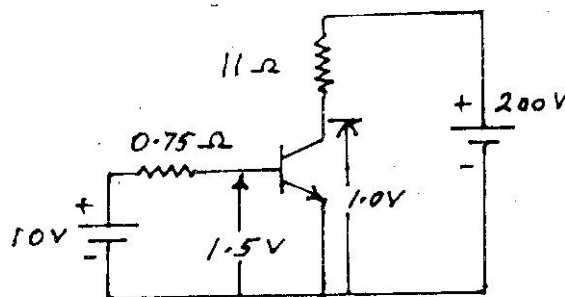


FIG. Qn. 2 c

(6 Marks)

3. (a) Using two transistor model, explain how a small gate current can turn ON a S.C.R. when blocking forward voltage. (6 Marks)
- (b) With circuit diagram and waveforms, discuss the operation of R-C firing circuit for a half wave S.C.R. controlled rectifier. (8 Marks)
- (c) How many S.C.R.'s are required in a series string to withstand a.d.c voltage of 3500 volts in steady state, if the S.C.Rs have steady state voltage rating

of 1000V and the steady state derating factor is 30%? Assuming maximum difference in leakage current of S.C.R.s to be 10mA, calculate the value of voltage sharing resistances to be used. Draw the circuit showing the S.C.R.s and the voltage sharing resistances. (6 Marks)

4. (a) Distinguish between natural commutation and forced commutation for S.C.R with illustrative examples. (6 Marks)
- (b) With a circuit diagram and waveforms, explain the principle of self commutation of an S.C.R. Write down the general expression for your circuit when S.C.R is turned ON in a series L, C circuit with a d.c. supply voltage V_s and give the expression for $i(t)$. State the initial conditions assumed. What is the conduction time (commutation time) of the S.C.R.? (10 Marks)
- (c) A complementary commutation circuit as shown in FIG. Qn 4c has two S.C.Rs with specified minimum turn off time, t_{off} equal to $50\mu s$. Make necessary calculations and state whether the circuit components are correct for satisfactory commutation of S.C.Rs

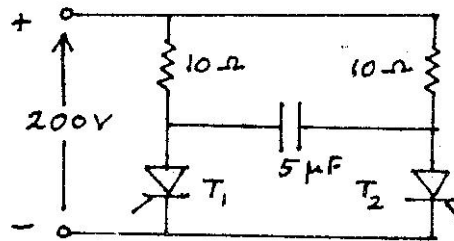


FIG. Qn.4.c

(4 Marks)

5. (a) For a.c voltage control, discuss the difference in performance between single phase unidirectional controller and bidirectional controller for a resistive load with circuit diagrams and output voltage waveforms. (6 Marks)
- (b) With a circuit diagram and waveforms of gating pulses and output voltage, explain the operation of a single phase ON-OFF type a.c voltage controller. Define duty cycle k and derive an expression for r.m.s output voltage. What are the applications for this method? (10 Marks)
- (c) A circuit of the above type with an input of 230V, 50Hz is connected to a resistive load of 20 ohms. The circuit is operating with the switch ON for 30 cycles and OFF for 30 cycles.

Determine :

- i) r.m.s. output current and
- ii) input power factor.

(4 Marks)

6. (a) Show the circuit diagram of a single phase semiconverter and explain the operation, assuming constant load current. Sketch waveforms of output voltage and current in one S.C.R for a firing angle, $\alpha = 45^\circ$. (10 Marks)
- (b) With circuit diagram, explain the operation of a three phase full converter for constant load current. If the input to this circuit is 3 phase, 50Hz a.c supply, determine the firing angle, α , for the S.C.R.s to obtain an output average d.c voltage of 50% of the maximum. If this output voltage is 270 volts, calculate a.c. supply line to line r.m.s voltage. (10 Marks)

Contd.... 3

7. (a) With circuit diagram, equivalent circuits and waveforms of load voltage and load current, discuss the operation of a step down d.c chopper with R-L load. Distinguish between continuous and discontinuous current modes of operation. (10 Marks)
- (b) Draw the schematic circuit of a class E four quadrant d.C. chopper and mention the devices that provide the path for current in the first and third quadrants of operation. (6 Marks)
- (c) Considering the switch to be ideal in the circuit of Fig. Qn. 7c, determine :
- the duty cycle, k for which the output average d.c. voltage and r.m.s. voltage are equal
 - the chopper efficiency.

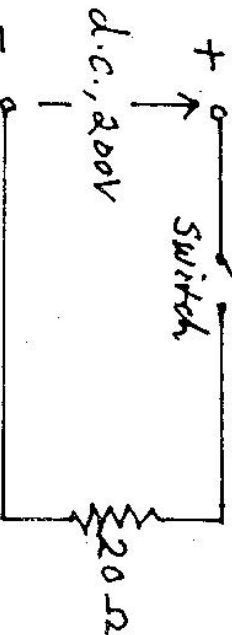


FIG. Qn. 7c

(4 Marks)

8. (a) With circuit diagram of a half bridge transistor inverter, explain the operation. Sketch waveforms of output voltage and current in devices, for a resistive load. Derive an expression for output r.m.s voltage. If your circuit uses additional diodes, what is their function? (10 Marks)
- (b) Considering a single phase bridge inverter, explain the phase displacement method of output voltage control. If the d.c input voltage is 200 volts and the required r.m.s fundamental output voltage is 90 volts, determine the delay angle, β . (10 Marks)