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06EC73

**Seventh Semester B.E. Degree Examination, December 2010**  
**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. Mention and explain the different types of power electronic converter systems. Draw their input/output characteristics. (06 Marks)
  - b. Mention and explain the classification of power semiconductor switching devices, on the basis of control characteristics. Give an examples. (06 Marks)
  - c. Give symbol, characteristic features of the following devices :  
 i) GTO ; ii) TRIAC ; iii) MOSFET ; v) MCT. (08 Marks)
2.
  - a. With the necessary waveforms, explain the switching characteristics of a power transistor. (08 Marks)
  - b. The bipolar transistor of Fig.Q.2(b) is specified to have  $\beta$  in the range 8 to 40. The load resistance is  $R_C = 11\Omega$ . The dc supply voltage is  $V_{CC} = 200V$  and the input voltage to the base circuit is  $V_B = 10V$ .  $V_{ce(sat)} = 1.0V$  and  $V_{BE(sat)} = 1.5V$ . Find : i) The value of  $R_B$  that results in saturation with an overdrive factor of 5 ; ii) The forced  $\beta_f$  ; iii) The power loss  $P_T$  in the transistor. (06 Marks)

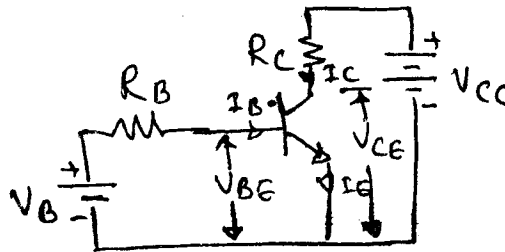


Fig.Q.2(b).

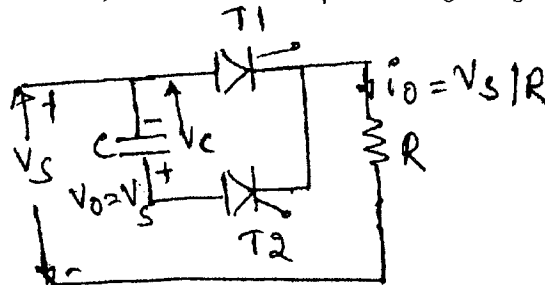
- c. Give the comparison between MOSFET and IGBT. (06 Marks)
3.
  - a. Draw the two transistor model of a thyristor and derive an expression for the anode current in terms of the common base current gain  $\alpha_1$  and  $\alpha_2$  of the transistors. (08 Marks)
  - b. Distinguish between :  
 i) Latching current and holding current.  
 ii) Converter grade thyristor and inverter grade thyristor.  
 iii) Thyristor turn – off time and circuit turn – off time. (08 Marks)
  - c. A thyristor is supplied from 230V, 50Hz mains. If the conduction angle is  $120^\circ$ , determine the voltage at which the thyristor is triggered. (04 Marks)
4.
  - a. With the necessary circuit and waveforms, explain the principle of operation of single phase full converter with R – L load. Derive an expression for the average output voltage. (08 Marks)
  - b. With a neat circuit diagram, and waveforms, explain the principle of operation of dual converter, with and without circulating current. (08 Marks)
  - c. What are the advantages and drawbacks of circulating current mode of operation of a dual converter? (04 Marks)

Important Note : 1. On completing your answers, carefully draw diagonal cross lines on the remaining blank spaces.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**PART - B**

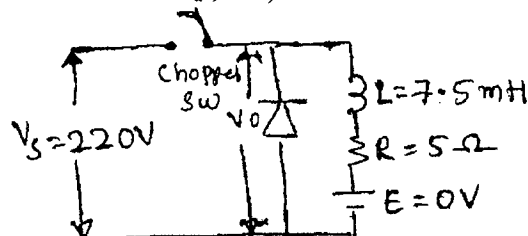
- 5 a. What do you mean by commutation? Explain briefly the different types of commutation. (08 Marks)
- b. With necessary circuit and waveforms, explain self commutation scheme. (06 Marks)
- c. In the impulse commutated thyristor circuit of Fig.Q.5(c), determine the available turn – off time of the circuit, if  $V_S = 200V$ ,  $R = 10 \Omega$ ,  $C = 5 \mu F$  and  $V_O = V_S$ . (06 Marks)

Fig.Q.5(c).



- 6 a. Define the following ;  
 i) Delay angle ; ii) Extinction angle ; iii) Conduction angle. (03 Marks)
- b. What problem is caused by sharp single pulse triggering in a 1  $\phi$  AC voltage controller, when the load is inductive? How can this be solved? (05 Marks)
- c. A 1  $\phi$  halfwave ac voltage controller has an input voltage of 230 V, 50 Hz and a load resistance of  $10 \Omega$ . The firing angle of thyristor is  $90^\circ$  in each positive half cycle. Find :  
 i) Average output voltage.  
 ii) RMS output voltage.  
 iii) The average thyristor current.  
 iv) The rms current value of the thyristor.  
 v) Diode average current.  
 vi) Diode rms current. (12 Marks)
- 7 a. Give the classification of choppers. Explain class E chopper with circuit and quadrant diagram. (06 Marks)
- b. A chopper is feeding an RL load as shown in Fig.Q.7(b). The chopper frequency is 1 kHz and duty cycle  $K = 0.5$ . Calculate :  
 i) The minimum instantaneous load current  $I_1$  ; ii) The peak instantaneous load current  $I_2$  ;  
 iii) The average value of load current  $I_a$  ; iv) The rms load current  $I_o$ . (08 Marks)

Fig.Q.7(b).



- c. With the help of a circuit diagram and waveforms, explain the working principle of a step - up chopper. (06 Marks)
- 8 a. What do you mean by inverters? Explain the principle of operation of 1  $\phi$  half bridge inverter. (08 Marks)
- b. Write and explain the performance parameters of an inverter. (06 Marks)
- c. With a neat circuit, explain the variable DC link inverter. (06 Marks)

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