

Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Power Electronics

Time: 3 hrs.

Max. Marks:100

Note : Answer FIVE full questions, choosing at least two questions from each part.

Part A

- 1
 - a. With neat circuit and waveforms of control signal and output voltage, explain the control characteristics of IGBT and SCR. (08 Marks)
 - b. Explain briefly the different types of thyristor power converters and mention two applications for each. (09 Marks)
 - c. What are the peripheral effects of power electronic circuits on load and source? (03 Marks)

- 2
 - a. Sketch and explain the switching characteristics of power BJT. The sketch should have the wave forms of i) V_{BE} ii) I_B iii) I_C . (06 Marks)
 - b. Sketch the structure of n - channel enhancement type MOSFET and explain its working principle. Also draw its transfer characteristics. (08 Marks)
 - c. The IGBT shown in the circuit of figure Q2 (c) has the following data:
 $t_{ON} = 3\mu\text{sec}$, $t_{OFF} = 1.2\mu\text{sec}$, Duty cycle $D = 0.7$, $V_{CE(Sat)} = 2V$, $f_s = 1\text{ kHz}$.
 Determine i) Average load current, ii) Conduction power loss, iii) Switching power loss during turn-on and turn-off. (06 Marks)

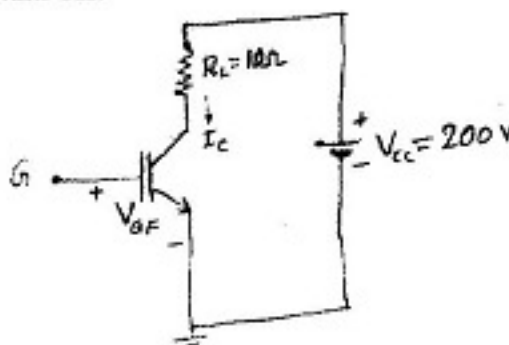


Fig. Q2 (c)

- 3
 - a. Using two transistor analogy, derive an expression for anode current of S.C.R. (06 Marks)
 - b. Calculate the required parameters for snubber circuit to provide $\frac{dv}{dt}$ protection to an SCR used in single phase bridge converter. The SCR has max $\frac{dv}{dt}$ capacity of $60V/\mu\text{sec}$. The input line-to-line voltage has a peak value of 425 V and the source inductance is 0.2 mH. Damping factor = 0.65. (04 Marks)
 - c. Mention the different turn-on methods employed to switch-on SCR. Explain with waveforms, the resistance triggering circuit to turn-on SCR in the phase control circuit. (10 Marks)

- 4
 - a. What do you mean by commutation in thyristors? Differentiate between natural commutation and forced commutation. (06 Marks)
 - b. For class-C commutation circuit shown in figure Q4 (b) the D.C. source voltage is 120 V, and the current through R_1 and $R_2 = 20\text{ A}$. The turn off time of both the SCRs is $60\mu\text{sec}$. Calculate the value of commutating capacitor 'C', for successful commutation. (06 Marks)

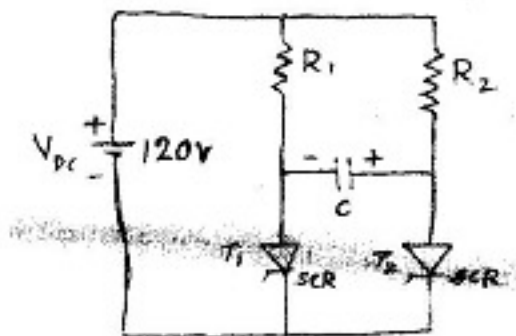


Fig. Q4 (b)

- c. With neat circuit and waveforms explain the operation of complementary commutation. (08 Marks)

Part B

- 5 a. Derive an expression for RMS value of the output voltage for single-phase full wave (bi-directional) AC voltage controller with resistive load. (10 Marks)
- b. An on-off controller, with an input of 230 V, 50 Hz is connected to a resistive load of 20Ω , the circuit is operating with the switch ON for 30 cycles and OFF for 30 cycles. Determine i) RMS output current ii) input power factor. (10 Marks)
- 6 a. With neat circuit and waveforms derive an expression for the RMS value of output voltage of single phase semi converter with RL load. (Assume discontinuous load current). (06 Marks)
- b. A single phase half wave controlled rectifier is used to supply power to 10Ω load from 230 V, 50 Hz supply at a firing angle of 30° . Calculate i) Average output voltage ii) Effective output voltage iii) Average load current. (06 Marks)
- c. With neat circuit and waveforms explain the working principle of 3 phase half wave controlled rectifier with 'R' load. (08 Marks)
- 7 a. A DC chopper shown in figure Q7 (a) has a resistive load of 10Ω and the input voltage, $V_s = 200V$. When the chopper switch is ON, its voltage drop is 2V and the chopping frequency is 1 kHz. If the duty cycle is 50%, determine i) Average output voltage ii) RMS output voltage, iii) The chopper frequency, iv) The effective input resistance of the chopper. (08 Marks)

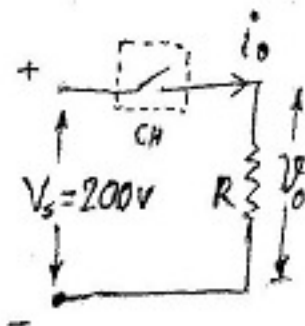


Fig. Q7 (a)

- b. With neat circuit, explain the working principle of impulse commutated thyristor chopper. (08 Marks)
- c. Explain briefly how choppers are classified. (04 Marks)
- 8 a. Obtain Fourier series for the output voltage waveform of full bridge inverter (single phase) with 'R' load. (10 Marks)
- b. With the help of neat diagram and waveforms, explain the operation of 180° mode of 3 phase inverter with star connected 'R' load. (10 Marks)