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**Seventh Semester B.E. Degree Examination, Dec.2014/Jan.2015**  
**Power Electronics**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.**

**PART - A**

- 1
  - a. Mention any four properties of a super power device should possess. (02 Marks)
  - b. What is a converter? How are power converters classified? Explain briefly. (08 Marks)
  - c. Mention some important advantages and disadvantages of power converters. (04 Marks)
  - d. What are the peripheral effects of power electronics converters and how they are overcome? (06 Marks)
  
- 2
  - a. The collector clamping circuit of Fig.Q.2(a) has the following parameters:  $V_{BB} = 14V$ ,  $R_B = 3\Omega$ ,  $\beta = 15$ ,  $V_{BE} = 0.7V$ ,  $V_{D2} = 0.9V$ ,  $V_{D1} = 2.1V$ ,  $R_C = 2\Omega$ ,  $V_{CC} = 120V$ , Find: i) Collector current without clamping; ii) Collector-emitter clamping voltage; iii) Collector current with clamping. (05 Marks)

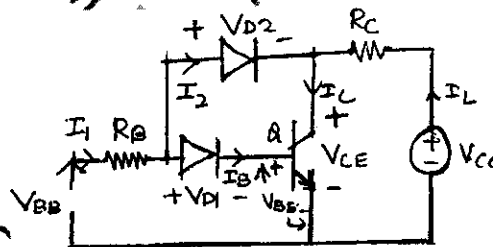


Fig.Q.2(a)

- b. Draw the switching model of MOSFET and explain its switching characteristics with neat figure. (06 Marks)
  - c. What is an IGBT? Compare IGBT with BJT and MOSFET. (05 Marks)
  - d. Why isolation is needed? Explain the two methods of isolation. (04 Marks)
  
- 3
  - a. With a neat figure explain the dynamic turn-on and turn-off characteristics of a thyristor. (08 Marks)
  - b. Briefly explain di/dt and dv/dt protection of SCR. (06 Marks)
  - c. Design a UJT relaxation oscillator for triggering an SCR, with UJT having the following parameters  $\eta = 0.72$ ,  $I_P = 60\mu A$ ,  $I_V = 4mA$ ,  $V_V = 2.5V$ ,  $V_{BB} = 15V$ ,  $R_{BB} = 5K\Omega$ , leakage current with emitter open is 3mA. Also calculate minimum and maximum value of RC (variable resistance). (06 Marks)
  
- 4
  - a. With a circuit diagram and waveforms explain the working of a single phase semi controlled rectifier. Derive an expression for the average voltage across the R-L load. (08 Marks)
  - b. For a single phase fully controlled bridge rectifier with highly inductive load and continuous current, obtain average load voltage and current if the load resistance is  $10\Omega$  and firing angle is  $45^\circ$ , and is fed from 230V, 50Hz supply. Draw the load voltage waveform and supply current waveform. (06 Marks)
  - c. What is a dual converter? Explain its operation with a neat circuit diagram. (06 Marks)

## PART - B

- 5 a. State the conditions to be satisfied for proper turn-off of SCR. (02 Marks)
- b. With the help of circuit diagram and waveforms explain the operation of self commutation. (06 Marks)
- c. In the Fig.Q.5(c) the source voltage  $V_s = 100V$  and the current through  $R_1$  and  $R_2$  is 25A. The turn off time of both the SCRs is  $40\mu\text{sec}$ . Find the value of capacitor for successful commutation and hence show that circuit turn off time is  $0.693 RC$ . (08 Marks)

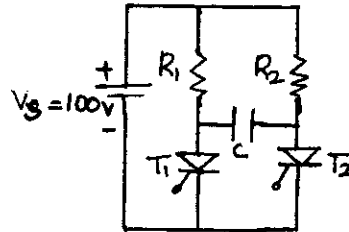


Fig.Q.5(c)

- d. In the auxiliary commutation circuit shown in Fig.Q.5(d) the battery voltage is 100V. Maximum load current is 40A and thyristor turn off time is  $40\mu\text{sec}$ . Assume 50% tolerance on turn off time. Find L and C of the commutation circuit. (04 Marks)

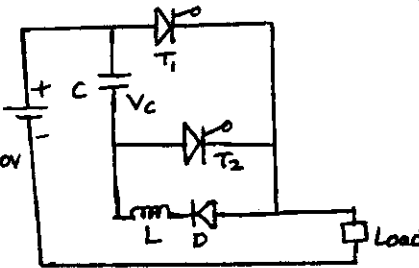


Fig.Q.5(d)

- 6 a. Distinguish between on-off control and phase control of AC voltage controller. (04 Marks)
- b. Explain the operation of single phase bidirectional AC voltage controller for inductive load with the help of circuit diagram and waveforms. (06 Marks)
- c. An AC voltage controller has a resistive load of  $R = 10\Omega$ , and RMS input voltage is  $V_s = 120V$ , 50Hz. The thyristor switch is on for  $n = 2$  cycles and off for  $m = 75$  cycles. Find: i) rms output voltage; ii) Input power factor; iii) Average and RMS thyristor current and hence derive the above expressions for  $V_{orm}$  and PF. (10 Marks)
- 7 a. Explain the working principle of step-down chopper and derive expression for i) Average output voltage; ii) Output power; iii) Effective input resistance in terms of chopper duty cycle. (08 Marks)
- b. With the help of a circuit diagram, explain four quadrant type E choppers. (08 Marks)
- c. A step up chopper has input voltage of 220V and output voltage of 660V. If the non conducting time of the thyristor is  $100\mu\text{sec}$ , compute the pulse width of the output voltage. If the pulse width is halved for constant frequency operation, find new output voltage. (04 Marks)
- 8 a. Explain a single phase full bridge inverter with relevant circuit diagram and waveforms. Assume R-L load. (08 Marks)
- b. With the help of circuit diagram and wave forms explain the operation of transistorized CSI (current source inverter). What are the advantages and disadvantages of CSI? (08 Marks)
- c. The single phase half bridge inverter has the DC input of 48V. The load resistance is  $4.8\Omega$ . Determine: i) RMS value of the output voltage; ii) RMS value of the fundamental component; iii) Total harmonic distortion. (04 Marks)

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