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10EC73

# 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, $R_B$ = 3Ω, β = 15, $V_{BE}$ = 0.7V, $V_{D2}$ = 0.9V, $V_{D1}$ = 2.1V, $R_C$ = 2Ω, $V_{CC}$ = 120V, Find: i) Collector current without clamping; ii) Collector-emitter clamping voltage; iii) Collector current with clamping. **(05 Marks)**

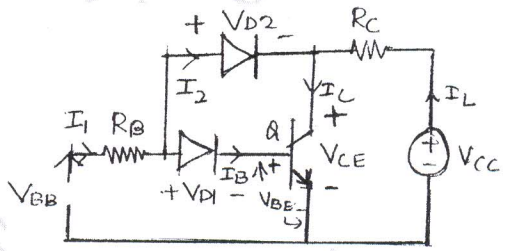


Fig.Q.2(a)

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 η = 0.72, $I_P$ = 60μA, $I_V$ = 4mA, $V_v$ = 2.5V, $V_{BB}$ = 15V, $R_{BB}$ = 5KΩ, 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 10Ω and firing angle is 45°, 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 40μsec. Find the value of capacitor for successful commutation and hence show that circuit turn off time is 0.693 RC. **(08 Marks)**

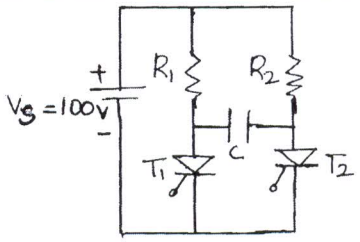


Fig.Q.5(c)

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 40μsec. Assume 50% tolerance on turn off time. Find L and C of the commutation circuit. **(04 Marks)**

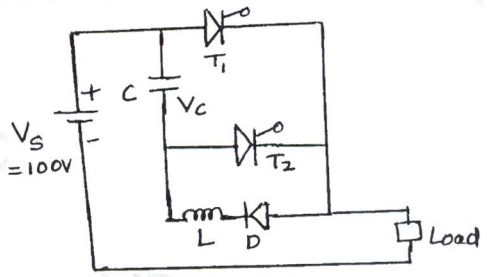


Fig.Q.5(d)

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 = 10Ω, and RMS input voltage is $V_S$ = 120V, 50Hz. The thyristor switch is on for n = 25 cycles and off form = 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 100μsec, 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 4.8Ω. 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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