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06EE45

# Fourth Semester B.E. Degree Examination, June-July 2009
## Power Electronics

Time: 3 hrs. Max. Marks:100

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

## PART – A

1 a. List out and explain the different types of Power Electronic converters. Show their output/input characteristics. **(08 Marks)**

b. What are the pheripheral effects of power converters. **(04 Marks)**

c. What is the necessity of base drive control in high power transistor? Explain proportional base and anti-saturation control. **(08 Marks)**

2 a. With necessary waveforms, explain the switching performance of power BJT. **(07 Marks)**

b. With relevant diagrams, discuss the methods for providing isolation of Gate/base drive control in power circuits and what are its limitations? **(07 Marks)**

c. In the circuit of Fig.Q2(c), the BJT has $\beta$ in the range 10 to 25. If $V_{CC} = 230V$, $R_C = 12\Omega$, $V_{BB} = 15V$, $V_{CE(Sat)} = 1.2V$ and $V_{BE(Sat)} = 1.8V$, calculate :

i) the value of $R_D$ required to move the transistor into saturation with an ODF of 6

ii) forced beta $\beta_f$ ; iii) total power dissipation.

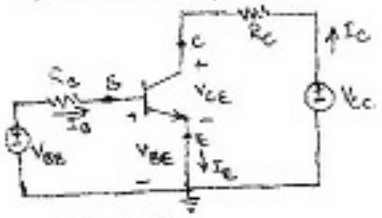


Fig.Q2(c)

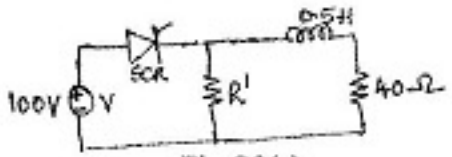


Fig.Q3(c) **(06 Marks)**

3 a. With neat sketch, explain the static V-I characteristics of an SCR? What are the significances of latching current, Holding current and Break over Voltage. **(08 Marks)**

b. With help of Two transistor Model of an SCR, derive the expression for anode current. There from explain the switching action and significance of Gate Control. **(08 Marks)**

c. The SCR in the circuit of Fig.Q3(c) has a latching current of 50 mA and if triggered by a Gate pulse width 50µ.sec. Show that with out resistance $R^1$ the thyristor will fail to remain ON when the gating pulse ends. Also find the maximum value of $R^1$ to ensure firing. The ON-State voltage drop of an SCR can be neglected. **(04 Marks)**

4 a. Define commutation? What are the necessity and conditions of commutation? Explain briefly types of commutation circuits. **(08 Marks)**

b. With necessary circuit and waveforms, explain complementary commutation scheme. Derive an expression for the same. **(08 Marks)**

c. Circuit of Fig.Q4(c) employing class-C commutation has $V_S = 200V$, $R_1 = 10\Omega$ and $R_2 = 100\Omega$. Determine : i) Peak value of current through thyristors $T_1$ ; ii) Value of capacitor C if each thyristor has turn-off time of 40 µ.sec. Take factor of safety as 2.

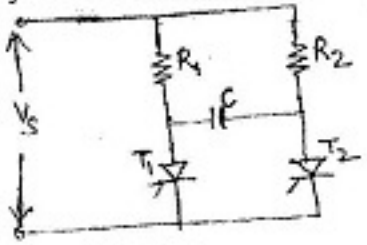


Fig.Q4(c) **(04 Marks)**

## PART – B

5 a. What is an A C voltage regulator (controller)? With the help of waveforms, explain ON-OFF control and phase control. **(06 Marks)**

b. Explain the operation of a single phase bidirectional controller with resistive load. Obtain the equation for r. m. s. and output voltage. Show the waveforms. **(08 Marks)**

c. The single phase full wave ACVC in Fig.Q5(c), operates on a single phase supply voltage of 230V rms at 50 $H_3$. If the triac is triggered at a delay angle of $\alpha$ (Alpha) = $45^0$ during both the half cycles of the input supply, calculate

i) rms value of the output voltage
ii) $I_{o(rms)}$ through the heater element
iii) Average value of the triac current
iv) rms value of triac current

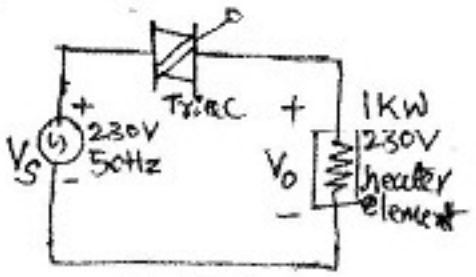


Fig.Q5(c) **(06 Marks)**

6 a. What is the use of freewheeling diode in converters? Explain the principle operation of single phase FWR feeding with RL load. Draw the relevant sketch and waveforms. **(06 Marks)**

b. With neat circuit and waveforms, explain the working of a line Commutated Converter, which works as rectifier and also as an Inverter. Derive an expression for its average output voltage. **(10 Marks)**

c. A single phase dual converter is supplying a load having R = 10Ω from an ac source of 230V, 50$H_3$. If the delay angle of the converters are $\alpha_1 = 60^0$ and $\alpha_2 = 120^0$ and the circulating current limiting inductance $L_r$ = 50 mH, calculate the peak value of the circulating current and the peak current through converter – 1. **(04 Marks)**

7 a. What is chopper? Classify and explain the different types of choppers with each circuit diagrams. **(06 Marks)**

b. With the help of circuit and quadrantal diagrams, explain the working of a class-E chopper. Mention the devices that gives path for the current in each quadrant. **(08 Marks)**

c. In the chopper circuit of Fig.Q7(c), the average output voltage is 109V. The voltage drop across the chopper switch when it is ON i.e. $V_S$ = 2V. If the load resistance R = 10Ω, f = 1.5KHz and duty ratio δ = 50%, calculate :

i) The dc Input voltage to the chopper.
ii) The rms output voltage
iii) The chopper efficiency
iv) Input resistance of chopper.

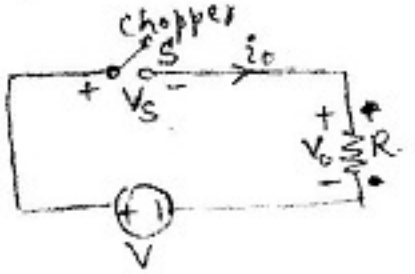


Fig.Q7(c) **(06 Marks)**

8 a. What do you mean by Inverters? Explain the operation of single phase full bridge inverter. Draw the load current waveforms for R, RL and RLC loads. **(06 Marks)**

b. Explain the operation of a three phase transistorized Inverter in $180^0$ conduction angle mode with Star-Connected Resistive load. **(08 Marks)**

c. Write a note on voltage Control of Single phase Inverter by Sinusoidal and multiple pulse width modulation techniques. Show their waveforms. **(06 Marks)**

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