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EC42

Fourth Semester B.E. Degree Examination, June / July 08
Power Electronics

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. List the major type of power electronic circuits and mention in each case the type of input supply given and the output obtained. **(08 Marks)**

b. What are the peripheral effects of power electronic components and equipments? How to eliminate them? **(06 Marks)**

c. Explain control characteristics of GTO, MCT, SITH with the help of waveforms and circuit diagrams **(06 Marks)**

2 a. Explain the terms over drive factor (ODF) and forced beta (β_f) for a power transistor in switching application. **(04 Marks)**

b. Name and explain various switching limits in case of power BJTS. With a circuit diagram, explain antisaturation control of BJT. Mention the improvement and drawback of this arrangement. **(08 Marks)**

c. Explain different methods of providing gate and base drive isolation. **(08 Marks)**

3 a. Using two transistor model, explain how a small gate current can turn ON a SCR when blocking forward voltage? **(06 Marks)**

b. Brief the working principle of a VJT relaxation oscillator with the help of a circuit diagram and show period of oscillation $T \approx RC \log_e\left(\frac{1}{1-\eta}\right)$. **(06 Marks)**

c. The input voltage of fig.Q3(c) is $V_S = 200V$ with load resistance of $R = 5\Omega$. The load and stray inductances are negligible. The thyristor is operated at a frequency of $f_s = 2$ kHz. If the required $\frac{dv}{dt} = 100V/\mu sec$ and the discharge current is to be limited to 100A, determine i) the value of R_s and C_s ii) the snubber loss and iii) the power rating of the snubber resistor. **(08 Marks)**

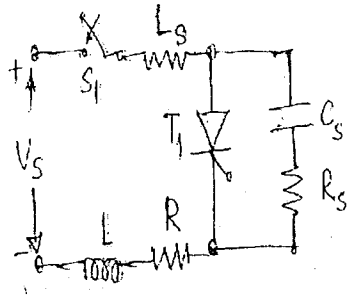

Fig. Q3.(c)

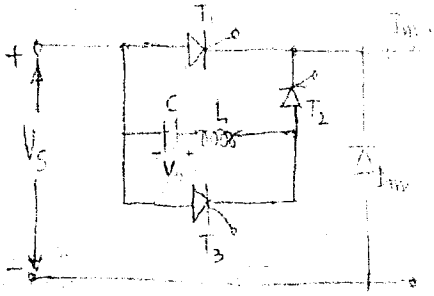

Fig. 4(c)

4 a. What is commutation? Distinguish between turn-off time made available by the commutation circuit and turn-off time of the device. **(04 Marks)**

b. Explain the working of an auxiliary commutation circuit to turn off a thyristor with the help of a circuit diagram and relevant waveforms. **(08 Marks)**

c. The resonant pulse commutation circuit in Fig.4(c) has a capacitance C = 30 μF and inductance L = 4μH. The initial capacitor voltage is $V_O = 200V$. Determine the circuit turn off time 't_{off}' if the load current I_m is i) 250 A ii) 50A. **(08 Marks)**

5 a. Discuss the working principle of a 1 ϕ, Full wave controller with RL load, with the help of a circuit diagram and waveforms. Derive the expression

$$\sin(\beta-\theta) = \sin(\alpha-\theta)\ \exp\left(\frac{R}{L}.\frac{(\alpha-\beta)}{\omega}\right)$$ with usual notations. **(08 Marks)**

b. An ac voltage controller in Fig.5(b) has a resistive load of R = 10Ω and the rms input voltage is V_S = 120V, 60Hz. The thyristor switch is on for n = 25 cycles and is off for m = 75 cycles. Determine the i) rms output voltage 'V_o' ii) input power factor PF and iii) average and rms current of thyristors. (06 Marks)

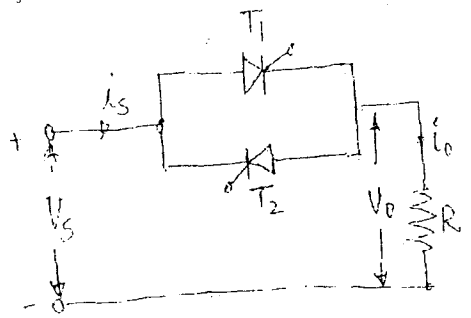

Fig 5(b)

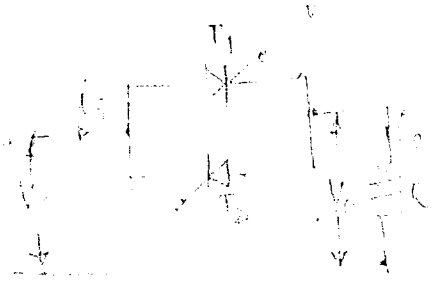

Fig.5(c)

c. A 1ϕ, Full wave ac voltage controller in fig.5(c) has a resistive load of R = 10Ω and th input voltage is V_s = 120V(rms), 60Hz. The delay angles of thyristors T_1, T_2 are equal $\alpha_1 = \alpha_2 = \alpha = \pi/2$. Determine i) the rms output voltage 'V_o' ii) the input power facto PF, iii) the average current of thyristors I_A, and iv) the rms current of thyristor 'I_R'. (06 Mark

6 a. Explain the working principle of 1ϕ, semi converter with RL load using circuit diagra and relevant waveforms. Derive expressions for load currents during time interv $0 < \omega t < 2\pi$ while evaluating it at $\omega t = \alpha$ and $\omega t = \pi$. (14 Mark

b. The single phase dual converter in fig.6(b) is operated from a 120V, 60Hz supply and t load resistance is R = 10 Ω. The circulating inductance L_r = 40 mh ; delay angles a $\alpha_1 = 60^0$ and $\alpha_2 = 120^0$. Calculate the peak circulating current and the peak current converter 1. (06 Mark

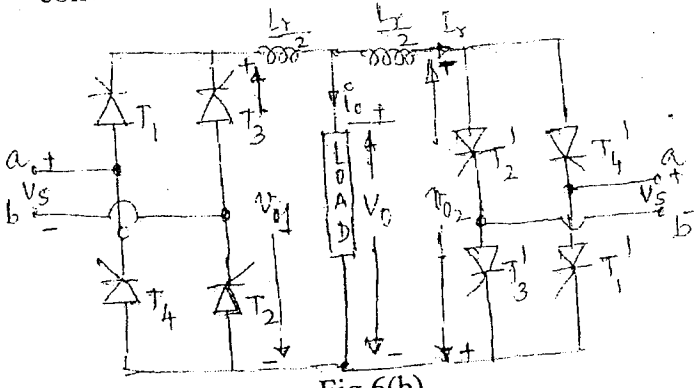

Fig.6(b)

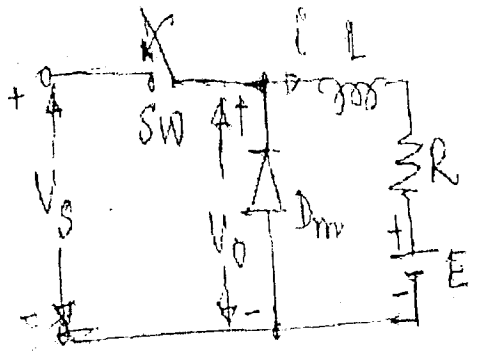

Fig.7(b)

7 a. Describe the operation of step-down chopper with RL load. Derive an expression maximum ripple of continuous current. (10 M

b. The chopper in fig.7(b) has a load resistance R = 0.25 Ω, input voltage V_S = 550V, battery voltage E = OV. The average load current I_a = 200A, and chopping frequ f = 250 Hz. Use the average output voltage to calculate the load inductance 'L' w would limit the maximum load ripple current to 10% of I_a. (10 M

8 a. Explain the principle of operation of 1ϕ, inverter with the help of circuit diagram (10 M waveform. (04 M

b. What are the advantages of a current source inverter?

c. A single phase full bridge inverter using transistor switches has a resistive lo R = 10Ω and the dc input voltage is 220V. Calculate
i) the rms output voltage at the fundamental frequency ii) the output powe
iii) the average and peak values of transistor current. (06 M

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127 Vb 2002 SCHEME

EC42

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

Power Electronics

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***

2. ***Missing data may be suitably assumed.***

1 a. Explain briefly the different types of power electronic circuits. **(05 Marks)**

b. Discuss peripheral effects of power electronics equipments. **(05 Marks)**

c. Explain turn-on and turn-off characteristics of SCR. **(10 Marks)**

2 a. Compare power MOSFETs and bipolar junction transistors. **(05 Marks)**

b. Draw and explain the dynamic characteristic of IGBT. **(05 Marks)**

c. For the BJT circuit shown in figure Q2 (c), if $V_{BE(sat)} = 1.5V$, $V_{CE(sat)} = 1.2V$, $\beta = 25$, $V_{CC} = 10V$, $R_C = 10\Omega$ and $R_B = 20\Omega$. Find i) Minimum voltage off V_{BB} required to ensure transistor saturation ii) On-state power loss in the transistor. **(05 Marks)**

d. Discuss methods of providing isolation of gate/base drive circuits from power circuits. **(05 Marks)**

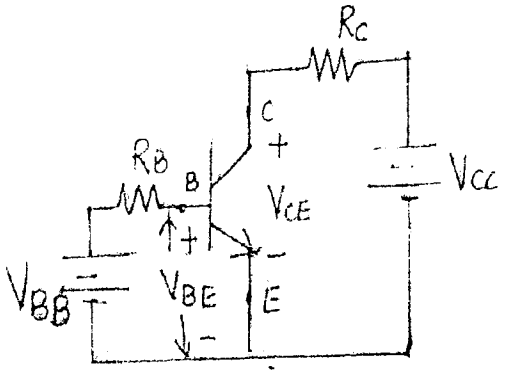

Fig. Q2 (c)

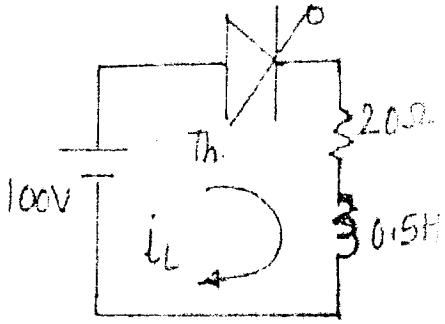

Fig. Q3 (b)

3 a. With two transistor model explain switching action of thyristor. Derive an expression for anode current. **(10 Marks)**

b. The thyristor in figure Q3 (b) has a latching current level of 50 mA and width of triggering pulse is 50 μsec. Find out whether the thyristor can be turned on successfully or not. **(04 Marks)**

c. Design UJT firing circuit shown in figure Q3 (c). The parameters of UJT are : $V_S = 20V$, $\eta = 0.66$, $I_p = 10\ \mu A$, $V_v = 2.5V$, $I_v = 10mA$. The frequency of oscillations is $f = 1$ kHz. The pulse width is $t_g = 40\ \mu sec$. **(06 Marks)**

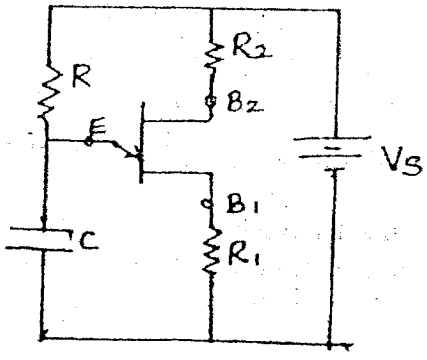

Fig. Q3 (c)

4 a. Distinguish between natural commutation and forced commutation. (04 Marks)

b. Commutation circuit for an SCR by resonating load is shown in figure Q4 (b). Check whether the SCR will be self commutated or not. If SCR is self commutated, calculate the voltage of the capacitor at the time of commutation. (06 Marks)

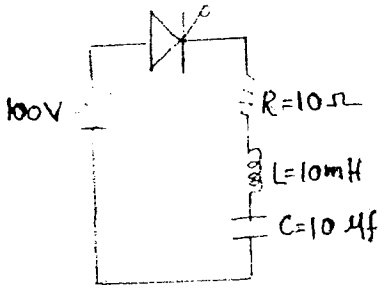

Fig. Q4 (b)

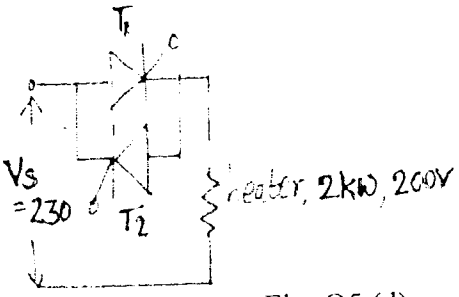

Fig. Q5 (d)

c. With neat circuit diagram and waveforms explain the working of complementary commutation. (10 Marks)

5 a. Draw the circuit of a single phase full wave AC voltage controller with "RL" load and sketch the output voltage and current and thyristor current waveforms. Derive expression for RMS output voltage. Also explain its operation. (08 Marks)

b. Distinguish between on-off control and phase control of AC voltage controllers. (04 Marks)

c. An on-off type of AC voltage controller is operating with a resistive load of R = 10Ω and the RMS supply voltage is 230 V. The controller remains on for 40 cycles and off 6 cycles. Determine i) RMS load voltage. ii) Input power factor. (04 Marks)

d. In the circuit of figure Q5 (d), if the load is 2 KW, 230 V, heater and $V_s = 230V$, 50 Hz Calculate i) $V_{Load-rms}$ ii) Power dissipated in the heater for $\alpha = 45^\circ$. (04 Marks)

6 a. Explain with the help of waveforms, fully controlled single phase converter with "RL load. (08 Marks)

b. A single phase half controlled rectifier is used to supply power to a load of 10Ω, fro 230V, 50 Hz AC supply at firing angle 30°. Calculate: i) Average output volta ii) effective output voltage iii) average load current. (05 Marks)

c. What is a freewheeling diode? What are the advantages of freewheeling diode in rectifi circuits feeding inductive load. (03 Marks)

d. Draw the circuit diagram of a single-phase dual converter. What are the advantages a disadvantages of circulating current mode dual converter? (04 Marks)

7 a. Explain how DC choppers are classified with reference to load voltage and load curre (10 Mar

b. Write a short note on: step-up chopper. (04 Mar

c. A DC chopper, of type A has a resistive load R = 20Ω and input voltage of 220 V. W chopper remains on, its voltage drop is $V_{Ch} = 1.5V$ and chopping frequency is 10 kHz duty cycle is 80%, determine i) Average output voltage ii) rms output voltage iii) chop efficiency iv) effective input resistance Ri. (06 Ma

8 a. With the necessary circuit diagram and waveforms. Explain the operation of single-ph half bridge inverter. (06 Ma

b. Define the performance parameter of the inverters. (04 Ma

c. With a circuit diagram explain the working of single-phase current source inverter. W are the advantages and disadvantages of current source inverter? (Note: CSI u transistor) (08 Ma

d. RMS value of fundamental component of output voltage in a single phase full br inverter employing displacement angle control is 80% of dc input. If there is one pul each half cycle calculate displacement angle 'β'. (02 M

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06EC73

Seventh Semester B.E. Degree Examination, Dec.09/Jan.10
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. Explain the control characteristics of SCR and GTO with circuit diagrams and wave forms of control signal and output voltage. **(08 Marks)**

b. Explain in brief the different types of power electronic converter circuits and mention the type of input supply given and its related output in each case. Also indicate two applications in each case. **(10 Marks)**

c. What is secondary break down? **(02 Marks)**

2 a. Compare an SCR with BJT. **(06 Marks)**

b. For the switching circuit shown in Fig. Q2(b) calculate :

i) The forced β of transistor

ii) The minimum ODF if the manufacturer specified β is 10

iii) The power loss P_T of the transistor. **(06 Marks)**

V_{CC} = 100V; V_B = 5V; R_B = 0.8 Ω; R_C = 12Ω; $V_{CE(sat)}$ = 1.0 V; $V_{BE(sat)}$ = 1.5 V.

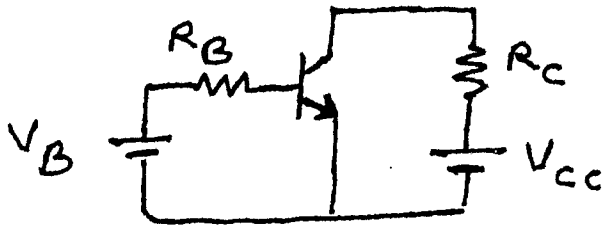

Fig. Q2(b)

c. What is the need for isolation of gate drive circuits? Discuss the different methods of providing isolation of gate drive circuits from power circuit. **(08 Marks)**

3 a. Explain the turn on mechanism of a thyristor using two transistor analogy and derive an expression for the anode current in terms of transistor parameters. **(08 Marks)**

b. In the thyristor circuit shown in Fig. Q3(b) the thyristor has a latching current of 20 m A and is fired by a gate pulse of width 50 μs. Show that without the resistance R, the thyristor will fail to remain ON. Also find the maximum value of 'R' to ensure firing. **(06 Marks)**

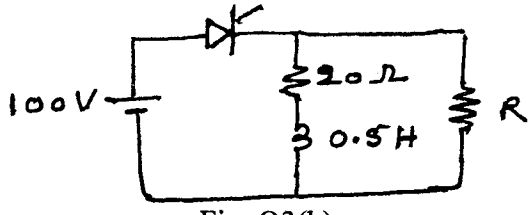

Fig. Q3(b)

c. With relevant circuit diagram and wave forms, explain the UJT relaxation oscillator. **(06 Marks)**

4 a. With a neat circuit diagram and wave forms explain the working of a single phase fully controlled converter with inductive load and continuous load current, also derive the expressions or average output voltage and rms output voltage. **(12 Marks)**

b. Give the comparison between circulating and non circulating current modes dual converter. **(05 Marks)**

c. What is the use of free wheeling diode in a converter circuit? **(03 Marks)**

PART – B

5 a. Explain the operation of impulse commutation with the relevant circuit diagram and waveforms. **(08 Marks)**

b. The commutation circuit for SCR by resonating load is shown in Fig. Q5(b). Verify whether the SCR will be self commutated or not. If the SCR is self commutated, calculate the voltage of the capacitor at the time of commutation. (Assume the initial conditions $V_C(0-) = I(0-) = 0$). **(08 Marks)**

V = 100 V
R = 10Ω
L = 10 mH
C = 10 μF

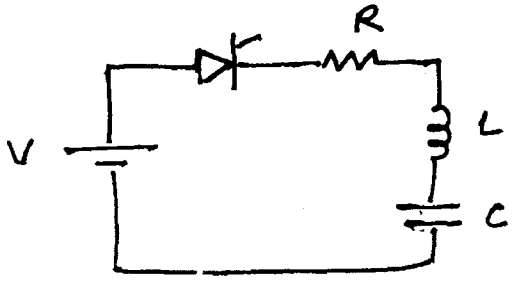

Fig. Q5(b)

c. State the conditions under which a load carrying thyristor can be successfully commutated. **(04 Marks)**

6 a. Draw the circuit diagram of a single phase AC voltage controller and explain the principle of ON-OFF control, with the help of relevant wave forms. Derive the expression for rms output voltage in terms of rms supply voltage and duty cycle of the operation of the controller. **(10 Marks)**

b. An AC voltage controller has a resistive load of 10Ω and rms input voltage 230V, 50Hz. The thyristor switch is ON for 25 cycles and OFF for 75 cycles. Determine
i) rms output voltage ii) input power factor. **(06 Marks)**

c. Distinguish between ON-OFF control and phase control of AC voltage controller. **(04 Marks)**

7 a. Explain the principle of operation of a step up chopper with suitable circuit diagram and waveforms. Derive the expression for average output voltage of step up chopper. **(10 Marks)**

b. Explain how the choppers are classified with reference to load voltage and load current. **(06 Marks)**

c. A DC chopper has a resistive load of 20Ω and input voltage 220V. When the chopper is ON its voltage drop is 1.5 V and chopping frequency is 10 KHz. If the duty cycle is 80% determine the average output voltage and rms output voltage. **(04 Marks)**

8 a. Explain the operation of single phase full bridge inverter with necessary circuit diagram and waveforms. Derive the expression for its rms value of output voltage. **(10 Marks)**

b. Explain the performance parameters of inverters. **(06 Marks)**

c. A single phase full bridge inverter has a resistive load of 2.4Ω and the DC input voltage of 48V. Determine
i) rms output voltage at the fundamental frequency
ii) output power. **(04 Marks)**

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