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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)**

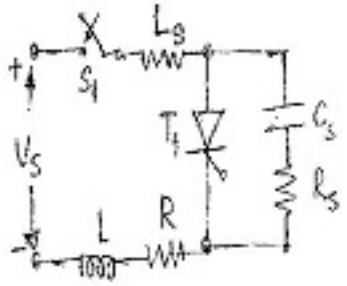

Fig. Q3.(c)

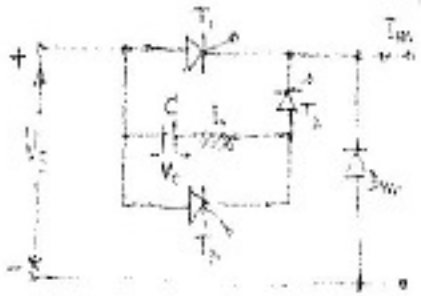

Fig. 4(c)

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 $C = 30\ \mu F$ and inductance $L = 4\mu H$. 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 1ϕ, Full wave controller with RL load, with the help of a circuit diagram and waveforms. Derive the expression

$$\sin(\beta-\theta) = \sin(\alpha-\theta)\ \exp\left(\frac{R}{L}\cdot\frac{(\alpha-\beta)}{\omega}\right)$$ 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)**

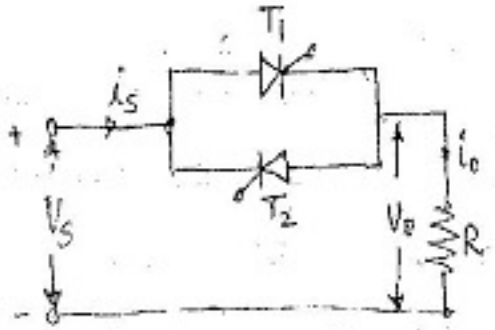

Fig 5(b)

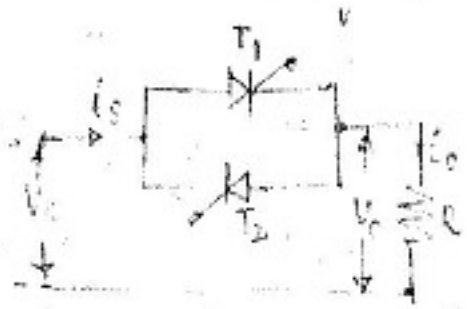

Fig.5(c)

c. A 1ϕ, Full wave ac voltage controller in fig.5(c) has a resistive load of R = 10Ω and the 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 factor PF, iii) the average current of thyristors I_A, and iv) the rms current of thyristor 'I_R'. **(06 Marks)**

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

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

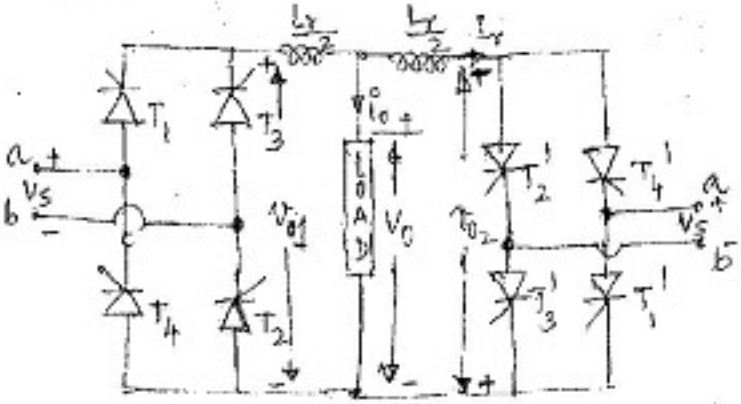

Fig.6(b)

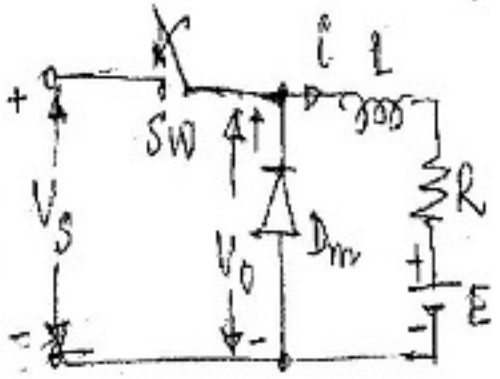

Fig.7(b)

a. Describe the operation of step-down chopper with RL load. Derive an expression for maximum ripple of continuous current. **(10 Marks)**

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

a. Explain the principle of operation of 1ϕ, inverter with the help of circuit diagram and waveform. **(10 Marks)**

b. What are the advantages of a current source inverter? **(04 Marks)**

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

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