NEW SCHEME

EC42

Reg. No. | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, January/February 2006

EC/TE/BM/ML/EE/IT

Power Electronics

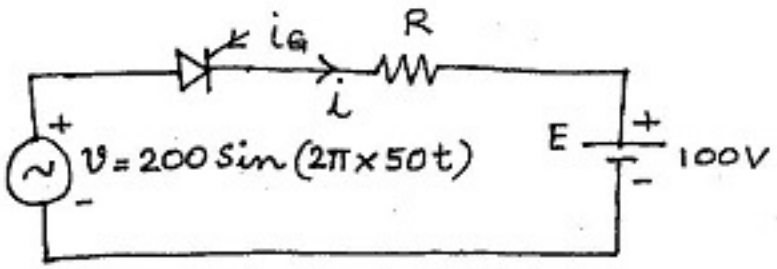
Time: 3 hrs.) (Max.Marks : 100

Note: *1. Answer any FIVE full questions from the following.*
2. All questions carry equal marks
3. Justify any assumptions made.

1. **(a)** What is a power converter ? List the different types of power converters and mention their conversion functions. **(7 Marks)**

(b) What are the peripheral effects of power electronic circuits ? What are the remedies for them ? **(5 Marks)**

(c) The thyristor shown in the circuit of Fig Q. 1(c) is triggered by a dc signal applied to the gate. Calculate i) the average value of current i, ii) power loss in the resistor. **(8 Marks)**

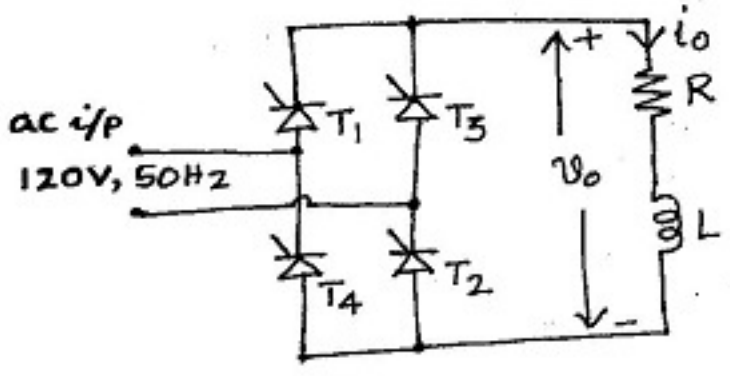


2. **(a)** The single phase full converter shown in fig Q. 2(a) is operating from a $120V, 50Hz$ supply and provides an average load current of 5A at a delay angle of $\alpha = 30^0$. If the ripple content of the load current is negligible, calculate

i) dc load voltage and dc output power

ii) the quantities mentioned in (i) if a freewheeling diode is connected across the output for the same load resistance and delay angle and

iii) the dc load voltage and current if thyristor T_3 is open circuited. Assume same load resistance and firing angle and a freewheeling diode across the load. **(10 Marks)**

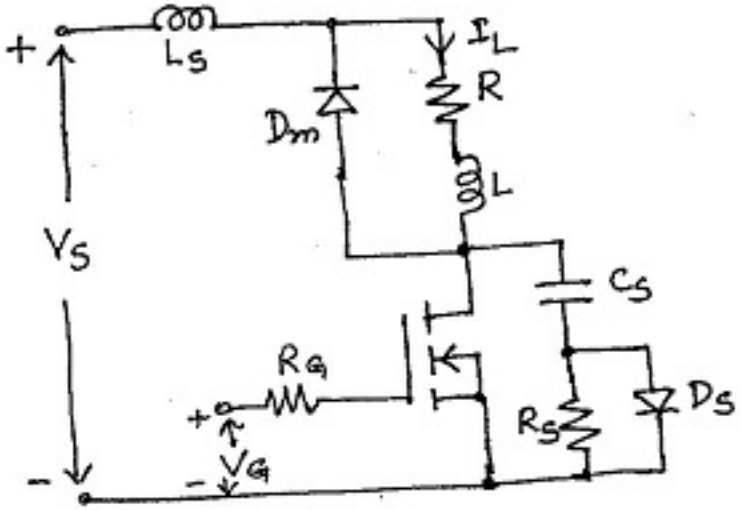


(b) Draw the circuit diagram of a single phase dual converter with RL load. Sketch the waveforms of input voltage, output voltage of converter 1, output voltage of converter 2 and voltage across the circulating inductor. Assume $\alpha = 60^0$. Mention any two advantages of circulating current mode of operation of dual converters. **(10 Marks)**

3. (a) Explain how antisaturation base control improves the switching performance of a BJT. **(6 Marks)**

(b) With the help of switching waveforms explain the switching times of a power MOSFET. **(7 Marks)**

(c) A MOSFET is operated as a chopper switch at a frequency of $f_s = 50kHz$. The circuit arrangement is shown in fig Q 3(c). The dc input voltage of the chopper is $V_s = 30V$ and the load current is $I_l = 40A$. The switching times are $t_r = 60ns$ and $t_f = 25ns$.
Determine the values of i) L_s, ii) C_s, iii) R_s for critically damped condition and iv) R_s if peak discharge current is limited to 5% of load current. **(7 Marks)**



4. (a) Distinguish between :

i) Latching current and holding current of a thyristor

ii) Converter grade and inverter grade thyristors. **(4 Marks)**

(b) Define turn -off time of thyristor and mention any two factors that affect it. **(3 Marks)**

(c) Ten thyristors are used in a string to withstand a dc voltage of $V_S = 15kV$. The maximum leakage current and recovery charge differences of thyristors are $10mA$ and $150\mu C$ respectively. Each thyristor has a voltage sharing resistance of $R = 56k\Omega$ and capacitance of $C_1 = 0.5\mu F$. Determine

i) the maximum steady state voltage sharing $V_{DS}(max)$,

ii) the steady state voltage derating factor,

iii) the maximum transient voltage sharing $V_{DT}(max)$ and

iv) The transient voltage derating factor. **(8 Marks)**

(d) Briefly explain RC triggering circuit for full wave control. **(5 Marks)**

5. (a) What do you mean by commutation ? What are the conditions to be satisfied for commutation of a thyristor ? **(4 Marks)**

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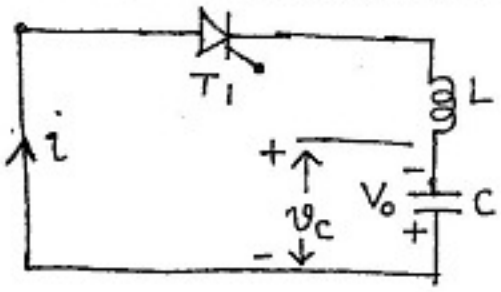
(b) In fig Q 5(b) the initial capacitor voltage $V_0 = 500V$, capacitance $C = 25\mu F$ and inductance $L = 10\mu H$. Determine the peak value of resonant current and the conduction time of thyristor T_1. Derive the expressions used. **(8 Marks)**



(c) With the help of a neat circuit diagram and relevant waveforms explain the operation of a complementary commutation circuit. **(8 Marks)**

6. (a) Mention the advantages and disadvantages of on-off control method of ac voltage control. **(3 Marks)**

(b) A singe phase full wave ac voltage controller using two thyristors in antiparallel has a resistive load of $R = 1.5\Omega$ and the input voltage is $120V(rms), 50Hz$. IF the desired output power is $P_0 = 4.53kW$ determine
i) the delay angles of the thyristors T_1 and T_2,
ii) the rms output voltage and output current,
iii) the input power factor, PF and
iv) the rms current of each thyristor. **(11 Marks)**

(c) Explain why short duration single gate pulses are not suitable for triggering thyristors in a full wave ac voltage controller with inductive loads. **(6 Marks)**

7. (a) With the help of a neat circuit diagram explain the principle of working of a step - down chopper. **(6 Marks)**

(b) In a step - down chopper, the source voltage is $220V$ dc. The load circuit parameters and $R = 10\Omega$ and $L = 5mH$. If the chopper is operating at a frequency of $200Hz$ and the ON/OFF ratio of the chopper is 2 : 1 calculate

i) the average load current,

ii) the maximum and minimum values of instantaneous load current under steady state conditions. **(7 Marks)**

(c) Explain how the principle of step-up chopper can be used to transfer energy from a low voltage dc source to a high voltage dc source. **(7 Marks)**

8. (a) A single phase full bridge inverter has a resistive load of $R = 10\Omega$ and the dc input voltage is $V_s = 220V$. Calculate i) the rms output voltage at the fundamental frequency, V_1, ii) the average rms and peak currents of each transistor switch, iii) the output power, P_0 and iv) the peak off-state voltage of each transistor, V_{BR}. **(6 Marks)**

(b) Draw the circuit diagram of a three phase bridge inverter with wye connected resistive load. Sketch the gating signals and line to line output voltages for 180^0 conduction operation. **(7 Marks)**

(c) With the help of neat waveforms explain the principle of multiple pulse width modulation method of output voltage control in a single phase inverter. Write the expression for the rms output voltage. **(7 Marks)**

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