NEW SCHEME

EC42

USN | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, July/August 2005

EC/TE/BM/ML/EE/IT

Power Electronics

Time: 3 hrs.] [Max.Marks : 100

Note: ***1) Answer any FIVE full questions.***
2) All questions carry equal marks

1. (a) Explain the turn-on and turn off characteristics of the SCR. **(8 Marks)**

(b) A thyristor has a forward characteristic which may be approximated by a straight line shown in the following figure. Calculate the mean power loss for

i) a continuous on state current of 23 A.

ii) a half sine wave of mean value 18A

iii) A level current of 39.6A for one half cycle. **(6 Marks)**

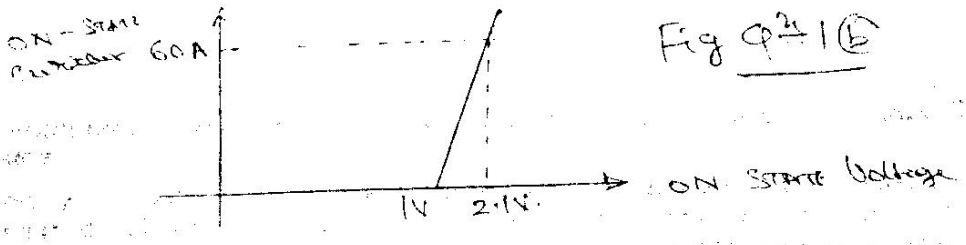

Fig Q1 (b)

(c) The input voltage to circuit shown below is $V_s = 200volts$ with a load resistance of $R = 10\Omega$ and a load inductance of $L = 50\mu H$. If the damping ratio is 0.7 and discharging current of capacitor is 5A, determine :

i) the values of R_s & C_s

ii) Maximum $\frac{dv}{dt}$ **(6 Marks)**

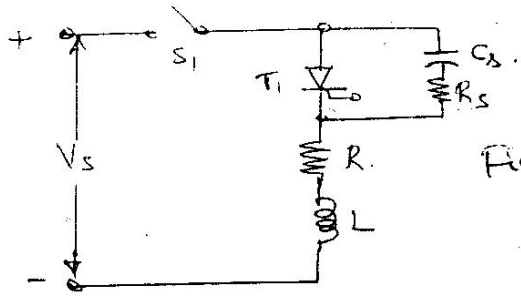

Fig Q1 (c)

2. (a) List the different types of power electric circuits. **(4 Marks)**

(b) Describe briefly the various base drive control methods used in Juverion transistors. **(10 Marks)**

Contd.... 2

(c) In the circuit shown the BJT is acting as a chopper switch at a frequency of 15 KHz. E_{DC}=240V and load current is 100 Amps. The switching times are $t_d = 0$, $t_r = 1.5\mu sec$ and $t_f = 0.7\mu sec$. Calculate the values of

i) L_s and C_s

ii) R_s for critically damped conditions

iii) R_s if the discharge current is limited to 5% of load current

iv) Power loss due to snubber neglecting effect of inductor L_s on voltage of C_s. Assume that $V_{ce(sat)} = 0$. **(6 Marks)**

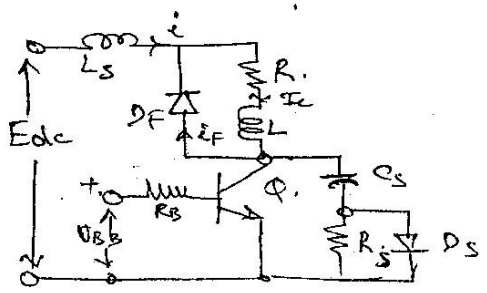

Fig Q2 ©

3. (a) Distinguish clearly between natural commudation and forced commutation. **(8 Marks)**

(b) With the help of a neat diagram and associated waveforms, explain the operation of a complementary commutation circuit. Derive an expression for the turn-off time assuming a resistive load. **(8 Marks)**

(c) For the commutation circuit shown in the following figure, $C = 20\mu F$ and $L_1 = 25\mu H$. The initial capacitor voltage is equal to input voltage i.e., $V_o = V_s = 200$ volts. If the load current I_m varies between 50A and 200 A, determine the variations in circuit turn-off. Derive any formulae you use. **(10 Marks)**

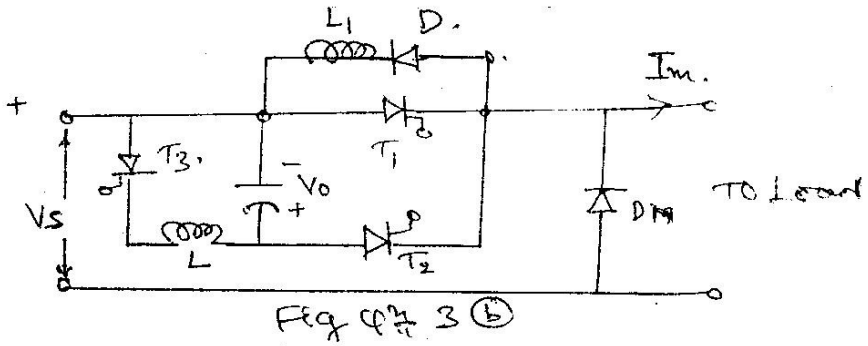

Fig Q3 (b)

Contd.... 3

4. (a) Compare and contrast on-off control with phase control as applied to AC voltage controllers. **(6 Marks)**

(b) A single phase half wave AC voltage controller shown in the following figure feeds power to a resistive load of 6Ω from 230V, 50Hz source. The firing angle of SCR is $\alpha = \frac{\pi}{2}$. Calculate :

i) Rms value of output voltage

ii) Input power factor

iii) Average input current. Derive any formulae you use for atleast two subdivisions.

(10 Marks)

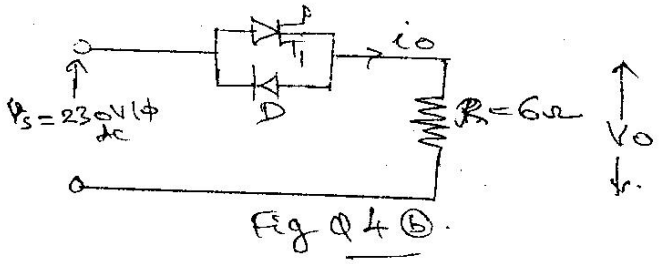

Fig Q4 (b).

(c) Explain why short duration pulses are not suitable for AC voltage controller with inductive loads. **(4 Marks)**

5. (a) A three phase fully controlled converter is operating with a highly inductive load. The load current is continuous and ripple free equal to Io
Determine :

i) Rms supply current ii) Displacement factor
iii) Distortion factor iv) Power factor
v) Harmonic factor.

(10 Marks)

(b) A single phase half wave rectifier has a transformer secondary voltage of 230 volts, 50 Hz and supplies a purely resistive load of $R = 1\Omega$. If the average output voltage is 25% of the maximum possible value of DC output voltage. Calculate : **(10 Marks)**

i) Delay angle of thyristor

ii) Rms and average value of output current

iii) Rms and average volume of thyrisor current

iv) Input power factor.

6. (a) Explain in detail how choppers are classified. **(10 Marks)**

(b) For an ideal type class A chopper circuit $V_s = 220volts$, $R = 5\Omega$, $L = 7.5mH$, $f = 1KHz$ and $E = 0$. Duty cycle $K = 0.5$. Calculate :

i) I_{min} & I_{max}

ii) ΔI i.e., peak to peak ripple current.

iii) Average and Rms value of load current.

iv) Effective input resistance of chopper.

v) Rms chopper current. **(10 Marks)**

Contd.... 4

7. (a) Define the performance parameter and inverters. **(4 Marks)**

(b) With necessary waveforms explain the operation of a single phase half-bridge inverter. **(10 Marks)**

(c) For a type A chopper circuit, $E_{dc} = 220V$, $f = 500Hz$. Duty cycle $k = 0.3$ and load $R = 1\Omega$, $L = 3mH$ and $E = 23$ Volts. Compare the following quantities.

i) Check whether the conversion is continuous or not.

ii) Average o/p current

iii) I_{max} & I_{min} **(6 Marks)**

8. (a) With the help of a neat diagram and associated w/F's, explain the operation of a three phase inverter employing 120^0 conduction strategy. **(10 Marks)**

(b) Explain :

i) Phase displacement technique.

ii) Multiple pulse width modulation technique.

used for controlling the output voltage of a single phase inverter. **(10 Marks)**

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