RE-7089-90
B. E. - III (Sem. VI) (EC) Examination
May / June – 2008
Industrial Electronics

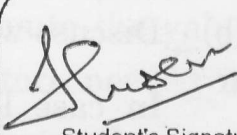Time : 3 Hours]   [Total Marks : 100

RE-7089

Instructions :

(1)

(2) Attempt all questions.

(3) Figures to the right indicate **full** marks.

(4) Assume suitable data if necessary.

(5) Use scientific calculator Casio Fx 82.83 or equivalent.

1 (a) Answer the following :   10

(1) Half wave converter is also known as half controlled converter true/false.

(2) Snubber circuit is used for _____ protection.

(3) In a single phase full controlled converter average output voltage is given by _____.

(4) In single phase converter _____ thyristors conduct during the overlap periode.

(5) What is the function of free-wheeling diode.

(6) A single phase half wave controlled converter always operates in the discontinuous conduction in mode.

(7) Define firing angle.

(8) State different operating mode of thyristors.

(9) In a 3-phase full converter diode rectifier if V_m is the maxi value of line voltage, then each diode is subjected to a peak inverse voltage of _____

(10) Turn on time for an SCR is 10 usec If an L inserted in the anode circuit than the turn off time will be more than 10 usec or less than 10 usec.

(b) Discuss what would happen to the circuit of Fig shown,   5 In case load is shifted between terminal a and b :
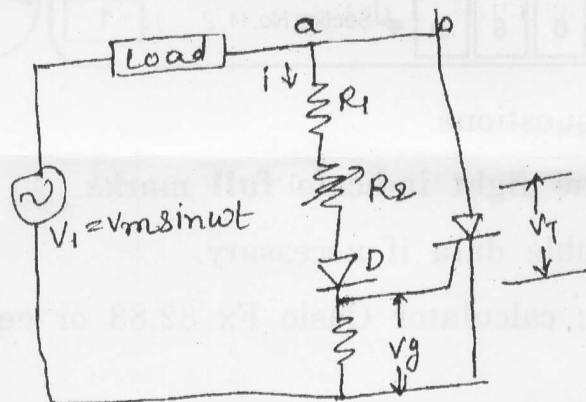
(c) SCRs with a rating of 1000 V and 200 A are   5 available to be used in a string to handle 6 kV and 1 kA. Calculate the number of series and parallel units required in case derating factor :
(1) 0.1 (2) 0.2

2   (a) Explain basic structure of IGBT. Also explain working   6 of it using equivalent circuit.

   (b) Latching current for an SCR inserted in between adc   7 voltage source is 200 V and the load is 100 mA. Compute the minimum width of gate pulse current required to turn-on this SCR in case load. Consist of :

(1) L = 0.2 H

(2) $R = 20\,\Omega$ in series with L = 0.2 H

(3) $R = 20\,\Omega$ in series with L = 2 H.

(c) Explain in brief a process of commutation failure.   2

OR

2   (a)   Classify different methods of commutation for thyristors.   7
Explain Class-A commutation.

(b)   A unijunction transistor used in relaxation Bcillator   8
has the following data :

$$n = 0.67,\, IV = 10\,mA,\, V_V = 2.5V,\, I_P = 10\,\mu A$$

An oscillator with an oscillator frequency of 1 kHz is
to be designed by using this UJT. Compute the value
of charging resistor and external resistors needed in
the base circuits. Take C = 0.4 μF and forward voltage
drop F–B junction as 0.5 V.

3   (a)   For single phase full converter derive the expression   8
below with source inductance effect

$$\cos(\alpha + \mu) = \cos\alpha - \frac{wls}{V_m} I_o.$$

(b)   (1)   A 3-phase full converter charges a battery from a   7
three phase supply of 230 V, 50 Hz. The battery
emf is 200 V and its internal resistance is 0.5 Ω
on account of inductance connected in series with
the battery, charching current is constant at 20 A.
Compute the firing angle delay and the supply
power factor.

(2)   In case it is desired that power flows from dc
sources to ac load in part (1), Find the firing angle
delay for the same current.

OR

3   (a)   A single phase controlled rectifier bridge consists   **7**
of one SCR and three diodes as shown in fig. sketch
output voltage waveform for a firing angle α for the
SCR and hence obtain an expression for the average
output voltage under the assumption of continuous
current. Show the condition of various components as
well.

(b)   Draw waveforms of current through T_1, D_1 D_2 and D_3
assuming constant load current.

(c)   For an ac source voltage of 230 V, 50 Hz and firing angle
of 45°, Find the average output current and power
delivered to battery in case load consists of $R = 5\,\Omega$,
$L = 8\,mH$ and $E = 100\,V$.
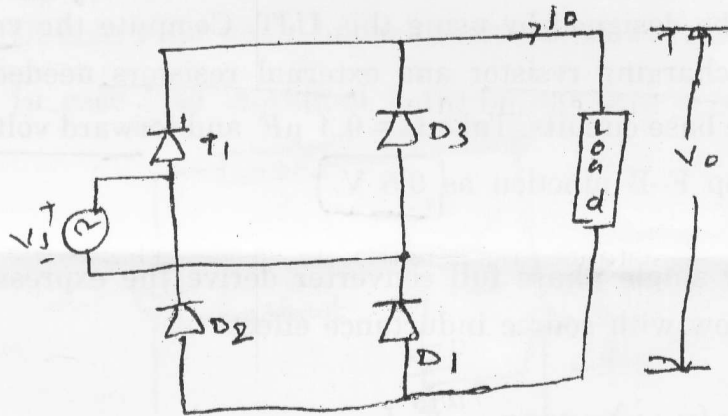
(b)   Explain Ideal Dual Converter.   **8**

RE-7090

Instructions :

(1)

(2)   Attempt all questions.

(3)   Figures to the right indicate **full** marks.

(4)   Assume suitable data if necessary.

(5)   Use scientific calculator Casio Fx 82.83 or equivalent.

4   (a)   Do as directed and attempt all questions in brief
          and precisely.

          (1)   A chopper has Vs as source voltage, R as load   2
                 resistance and α is the duty cycle. What is the rms
                 value of output voltage ?

          (2)   In dc choppers, per unit ripple is maximum when   2
                 duty cycle α is
                 (a) 0.2 (b) 0.5 (c) 0.7 (d) 0.9
                 Justify your answer.

          (3)   In dc choppers, if T is the chopping period, then   2
                 output voltage can be controlled by FM by varying:
                 (a)   T keeping Ton constant
                 (b)   T keeping Toff constant
                 (c)   Ton keeping T constant ✗
                 (d)   Toff keeping T constant. ✗
                 Write down all correct answer unambiguously.

          (4)   For an SCR how dv/dt protection is achieved ?   2

          (5)   Which condition is to be satisfied to operate full   2
                 bridge inverter in load commutation mode ?

(b) Protection : 6

Why di/dt protection is necessary for thyristors ? Explain techniques for protecting against di/dt.

(c) How thyristors can be protected against phenomenon called over current. 4

5 (a) Classify choppers and briefly explain working of all choppers. 8

(b) An RLE load is operating in a chopper circuit from a 500 volts source. For the load R = 0 ohm, L = 0.06H. For a duty cycle of 0.2, find the chopping frequency to limit the amplitude of load current excursion to 10A and E = 75 Volts. 7

OR

5 (a) Describe voltage commutated chopper with neat diagram explain working of this chopper taking reference of different mode of operation. 8

(b) The voltage commutated chopper has the following parameters : Vs = 220 Volts, Load : R = 0.5 ohm, L = 2 mH and E = 40 Volts.

Commutation circuit parameters : L = 20 micro H, C = 50 micro F, Ton = 800 micro Seconds T = 2000 micro seconds.

For a constant load current of 80 A, compute the following :

(a) Effective on period

(b) Peak currents through main thyristor T1 and auxiliary thyristor TA

(c) Turn off times for T1 and TA

(d) Total commutation interval

(e) Capacitive voltage 150 micro seconds after TA is triggered.

(f) Time needed to recharge the capacitor to voltage.

6 (a) A single phase full bridge inverter is connected to an 8
       RL load. For a DC source voltage of Vs and output
       frequency f = 1/T, obtain expression for load current as
       a function of time for the first two half cycles of output
       voltage. Also derive expression for steady state current
       for the first two half cycles.

   (b) For single phase full bridge inverter 7
       R = 20 ohm, L = 0.1 H obtain current expressions for
       load current in case source voltage is 240 V dc and
       frequency of output voltage is 50 Hz.

OR

6 (a) Describe techniques of pulse width modulated 8
       inverter, compare and contrast between single phase,
       multiphase and sinusoidal pulse inverters.

   (b) A single phase full bridge inverter, fed from dc 7
       source such that fundamental component of output
       voltage is 230 V, Find the rms value of thyristor
       and diode currents for the following loads :
       (a) R = 2 ohm
       (b) R = 2 ohm, X_L = 8 ohm and X_C = 6 ohm.