Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH/EE(O)/EEE(O)/SEM-5/EE-504/2012-13

2012

POWER ELECTRONICS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) Which semiconductor power device out of the following is not a current triggered device ?

a) SCR b) GTO

c) TRAIC d) MOSFET.

ii) The TRIAC can be used only in

a) inverter

b) rectifier

c) multi-quadrant chopper

d) cycloconverter.

iii) The range of firing angle in case of RC firing circuit will be

a) 0° - 90° b) 90° - 180°

c) 0° - 180° d) 45° - 90°.

iv) Each diode of a 3-phase halfwave diode rectifier conducts for

a) 60° b) 120°

c) 180° d) 90°.

v) SCR can be used as

a) amplifier

b) switch

c) both switch & amplifier

d) none of these.

vi) Reverse recovery current in a diode depends upon

a) forward field current b) storage charge

c) temperature d) PIV.

vii) The $\frac{di}{dt}$ rating of an SCR is specified for its

a) decaying anode current

b) decaying gate current

c) rising gate current

d) rising anode current.

viii) A UJT exhibits negative resistance region

a) before the peak point

b) between peak & valley points

c) after the valley point

d) both (a) and (c).

ix) In a commutation circuit employed to turn off an SCR, satisfactory turn off is obtained when

a) circuit turn-off time < device turn-off time

b) circuit turn-off time > device turn-off time

c) circuit time constant < device turn-off time

d) circuit time constant < device turn-off time.

x) In voltage source inverters

a) load voltage waveform V_o depends on load impedance Z, whereas load current waveform i_o does not depend on Z

b) both V_o and i_o depends on Z

c) V_o does not depend on Z whereas depends on Z

d) none of these.

xi) The output voltage waveform of a three phase square wave inverter contains

a) only odd harmonics

b) both odd and even harmonics

c) only even harmonics

d) only triplen harmonis.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following $3 \times 5 = 15$

2. Discuss the transfer, output and switching characteristics of power MOSFET.

3. Describe the different modes of operation using static V-I characteristics of thyristor. What is the effect of gate current on this characteristic. 4 + 1

4. Why snubber circuits are used in thyristor circuits ? Draw the complete protection circuit for the single phase converter and explain in detail. 2 + 3

5. Draw the R-C firing circuit for SCR and explain with proper waveforms. Why short pulses are preferred over long pulse signals for thyristor triggering through isolation transformer ? 3 + 2

GROUP – C

(Long Answer Type Questions)

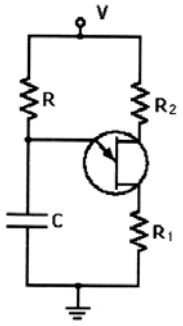
Answer any *three* of the following. $3 \times 15 = 45$

6. a) With the help of two transistor model describe the turn-on process of a thyristor.

   b) The duty cycle of pulse firing circuit is 0·25, while the on time is 30 μsec and the magnitude of the pulse is 10V. The gate cathode characteristic of an SCR being a straight line and its equation is $Eg = 1+10\ Ig$. Find the value of the series resistance if the given firing circuit is used to fire this SCR such that the peak or maximum power does not exceed 5 W at the gate circuit. Find the average value of the power dissipation in the gate. 7 + 8

7. a) Draw and explain the ramp triggering circuit for SCR using UJT.

b) Design the triggering circuit shown below. The parameters of the UJT are V = 20 V, η = 0·66, I_p = 10 μ, V_v = 2·5 V and I_v = 10 mA. The frequency of oscillation is 1 kHz, and the width of the gate pulse is $t_g = 40\,\mu s$. Assume diode voltage drop $(V_D) = 0 \cdot 7\,V$ and $C = 0 \cdot 5\,\mu F$.



7 + 8

8. a) Derive the expressions of average output voltage and load current for a 3φ full converter. Draw associated waveforms.

b) A two-pulse single phase bridge converter is connected to RLE load. Source voltage is 230 V, 50 Hz. Average load current of 10 amps is continuous over the working range. For R = 0·4 Q and L = 2 mH, compute (i) Firing angle delay for E = 120 V, (ii) Firing angle delay for E = –120 V. Indicate which source is delivering power to load in parts (i) and (ii). 8 + 7

9. a) A six pulse thyristor converter connected to a 400 V (L-L), 3-phase, 50 Hz *ac* system is supplying power to a 420V, 110 A *dc* motor. Calculate the firing angle of the converter, if the terminal voltage at the output is 420 V. Also calculate output power, TUF, *dc* and *rms* current through each transistor.

   b) Discuss the effect of source inductance for a thyristorised converter. 8 + 7

10. a) Explain the operation of an impulse communication circuit for a thyristor carrying a constant load current.

   b) The step down chopper has a resistive load of R = 10Ω, and the input voltage is 200V. When the chopper is turned on the voltage drop across the switch is 1V, the chopping frequency is f = 1 kHz. If the duty cycle is 40%, determine the average output voltage, *rms* output voltage, efficiency of the chopper and effective input resistance of chopper. 8 + 7

11. Write short notes on any *two* of the following : 2 × 7½

   a) Application of power semiconductor devices of HVDC system

   b) Induction heating

   c) Rectifier fed *dc* motor control

   d) TRIAC

   e) IGBT

   f) fly-back type SMPS.

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