Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS / B.TECH (ECE-NEW) / SEM-6 / EC-603/ 2011

2011

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)   An RC snubber circuit is used to protect a thyristor against

    a) False triggering   b) Failure to turn on

    c) Switching transients d) Failure to commutate.

    ii) When a power BJT is compared to power MOSFET,

    a) BJT has lower switching losses but higher conduction losses

    b) BJT has higher switching losses but lower conduction losses

    c) BJT has lower switching losses and conduction losses

    d) BJT has higher switching losses and conduction losses.

6204   [Turn over

iii) A single phase full converter can operate in
   - a) 4 quadrants
   - b) 3 quadrants
   - c) 2 quadrants
   - d) 1 quadrant.

iv) For an SCR, di/dt protection is achieved through the use of
   - a) R in series with SCR
   - b) RL in series with SCR
   - c) L in series with SCR
   - d) L across SCR.

v) A Flyback converter is operating at continuous mode has an input DC voltage of 200 volts and regulated load voltage of 16 volts. What should be the primary to secondary turns ratio of the transformer if the duty cycle is 80% ?
   - a) 20 : 1
   - b) 30 : 1
   - c) 25 : 2
   - d) 50 : 1.

vi) Reverse recovery current in a diode depends upon
   - a) forward field current
   - b) storage current
   - c) temperature
   - d) PIV.

vii) An IGBT has three terminals called
   - a) collector, emitter and base
   - b) drain, source and base
   - c) drain, source and gate
   - d) collector, emitter and gate.

viii) The most efficient gate-triggering signal for SCR is
   - a) a steady DC level
   - b) a short duration pulse
   - c) a high-frequency pulse train
   - d) a low-frequency pulse train.

ix) The main reason for connecting a pulse transformer at the output stage of an SCR firing circuit is to

    a) amplify power of the triggering pulse

    b) provide electric isolation

    c) reduce the turn on time of SCR

    d) avoid spurious triggering of SCR due to noise.

x) In a circulating current type of dual converter, the nature of voltage across reactor is

    a) alternating   b) pulsating

    c) direct   d) triangular.

xi) In voltage source inverters

    a) load voltage waveform v_0 depends on load impedance Z, whereas load current waveform i_0 does not depend on Z

    b) load voltage waveform v_0 and load current waveform i_0 depend on Z

    c) load voltage waveform v_0 does not depend on load impedance Z, whereas load current waveform i_0 depend on Z

    d) both v_0 and i_0 do not depend on Z.

xii) In a single phase full bridge VSI has inductor L as load. For a constant source voltage, the current through the inductor is

a) square wave   b) triangular wave

c) sine wave   d) pulse wave.

xiii) Switched Mode Power Supply (SMPS) is preferred over continuous types because SMPS

a) is suitable for both ACN and DC

b) is suitable for low power circuits

c) is suitable for high power circuits

d) provides low power loss.

GROUP – B
(Short Answer Type Questions)

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

2. Draw and explain a boost DC-DC converter. Write the expression for output voltage.

3. A thyristor is used to feed a load resistance 8 ohms from a 230V single phase supply. The ratings of thyristors are : Repetitive peak current = 300A, (di/dt) max = 40 A/ µ sec and (dv/dt)max = 150 V/ µ sec. Design a snubber circuit for protection of thyristor.
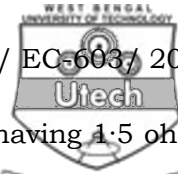
4. A step-up chopper supplies power to a load having 1·5 ohms resistance and 0·8 mH inductance. The source voltage is 50V DC and the load voltage is 75V. If the on-time is 1·5 ms, find

   a) the chopper switching frequency

   b) the average value of the source current

   c) I_{max}

   d) I_{min}.

5. What is commutation ? Explain current commutation and voltage commutation.

6. "SCR is self latching device." Explain the statement with the help of two transistor analogy of SCR.
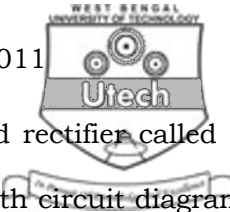
GROUP – C

(Long Answer Type Questions)

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

7. a) Describe the construction of IGBT.

   b) Explain its operation with the help of an equivalent circuit. State the advantages of IGBT.

   c) How di/dt and dv/dt protections are achieved in SCR ?

   d) Draw and explain nonisolated base drive circuit for BJT.

   $2 + 4 + 6 + 3$

8. a) Why is a three phase bridge controlled rectifier called a six pulse converter ? Explain briefly with circuit diagram and output voltage waveform.

   b) A three phase six pulse converter is operated from a 3 phase star connected 400 V 50 Hz supply and with *R-L* load (*R* = 10 ohm).

   It is required to obtain an average output voltage equal to 50% of the maximum possible output voltage of the rectifier.

   Find out at this condition

   i) the Firing Angle

   ii) the average output voltage

   iii) the average current of each thyristor

   iv) PIV requirement of each thyristor

   c) Explain how the above mentioned converter can act as rectifier and inverter. 6 + 6 + 3

9. a) Describe with the help of necessary voltage waveforms and circuit diagram, the operation of a three phase voltage source inverter with 180° conduction mode delivering power to star connected pure resistive load.

b) A single phase half-wave inverter feeds a resistive load R_L=10 Ω. Source voltage is 240V DC. Determine the r.m.s. voltage, output power and r.m.s. value of current. 10 + 5

10. a) Discuss any scheme of microprocessor based triggering angle control.

b) Write a note on resonant converter. 7 + 8

11. Write short notes on any *three* of the following : 3 × 5

i) Electronic ballast

ii) Induction Heating

iii) UPS

iv) Active front end converter

v) Need for power electronics converter.

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