Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH(EEE/EE-O)/SEM-5/EE-504/2011-12

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)   For continuous conduction each thyristor pair of a two pulse full converter should conduct for

a) π b) $\pi - \alpha$

c) α d) $\pi + \alpha$.

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.

5346   [Turn over

iii) Secondary breakdown occurs in

    a) GTO   b) IGBT

    c) BJT   d) TRIAC.

iv) 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°.

v) A cycloconverter is a

    a) DC to AC converter

    b) phase controlled converter

    c) DC to DC converter

    d) direct frequency changer.

vi) A chopper has V_s as the source voltage, R as the load resistance and α as the duty cycle. The rms value of the output voltage is

    a) αV_s b) $\sqrt{\alpha} V_s$

    c) $V_s / \sqrt{\alpha}$ d) $\sqrt{1-\alpha} V_s$.

vii) A single phase full bridge voltage source inverter has highly inductive load. For a constant source the load current is

    a)   square wave   b)   triangular wave

    c)   sine wave   d)   pulse wave.

viii) Switched mode power supply (SMPS) is preferred over continuous type because SMPS

    a)   is suitable for both AC and DC

    b)   is suitable for low power circuits

    c)   is suitable for high power circuits

    d)   provides low power loss.

ix) Bulk power transmission over long HDVC lines are preferred on account of

    a)   low cost HVDC terminals

    b)   no harmonic problem

    c)   minimum line power losses

    d)   simple protection.
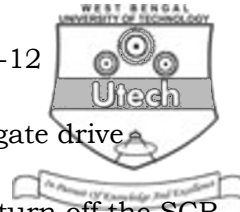
x) When a thyristor gets turned on, the gate drive

    a) should not be removed as it will turn off the SCR

    b) may or may not be removed

    c) should be removed

    d) should be removed to avoid increased losses and higher junction temperature.

xi) In a 3-phase controlled bridge rectifier, with an increase of overlap angle, the output *dc* voltage

    a) increases

    b) decreases

    c) does not change

    d) depends upon load inductance.

xii) The advantage of a 180° conduction three phase inverter over a 120° conduction three phase inverter is that

    a) it needs less number of switches

    b) there is no paralleling of switches

    c) devices in series are not simultaneous switches

    d) load terminals are not left open during switching.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following   3 × 5 = 15

2. Explain with two transistor analogy of an SCR, how positive feedback action takes place during turn-on of an SCR.

3. Distinguish clearly between voltage communication and current communication in an SCR circuit.

4. What is cyclo-converter ? Explain the operation of a single phase step-up cycloconverter.

5. Explain with the help of circuit diagram, the principle of operation of step-up chopper. Derive the expression of output voltage of such a chopper.

6. a) Define the term 'ripple factor' and 'rectification efficiency' for a converter.   2

   b) Why are freewheeling diode connected in rectifier circuits to cope up with *R-L* load ? (Give waveforms).   3

GROUP – C
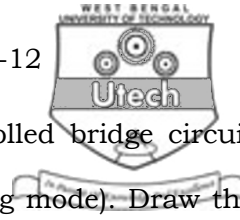
(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

7. a) For a 3-phase controlled half-wave rectifier feeding *R* load, show that the average output voltage is given by

$$V_0 = \frac{3}{2\pi} V_{mp} \left[1 + \cos\left(\alpha + \frac{\pi}{6} \right) \right]; \text{ for } \frac{\pi}{6} < \alpha < \frac{5\pi}{6}$$

where V_{mp} = maximum value of phase voltage, and

α = firing angle.

b) Explain the operation of fully controlled bridge circuit with *R-L* load (rectifying and inverting mode). Draw the waveform. 7 + 8

8. a) Draw the schematic circuit, the equivalent circuit for at least three modes of conduction, waveforms of gate pulses, phase voltages and line voltage of a three phase inverter with 120° conduction. List the merits and demerits of the circuit compared to 180° conduction.

b) Explain how the voltage of a single phase inverter is controlled by PWM techniques. 9 + 6

9. a) What is a *dc* chopper ? Describe the working of type-*B* chopper. Does it operate as a step-down or step-up chopper ? Explain.

b) What are the main two control strategies used for obtaining variable voltage from a *dc* chopper ? Which one of these is preferred over the other and why ?

c) A step-up chopper operating at 20 kHz has non-conductive time 20 micro-seconds. Calculate output voltage if input voltage is 100 V *dc*. 6 + 5 + 4

10. a) What is GTO ? Describe its basic structure.

b) Give the merits and demerits of GTOs as compared to conventional thyristors.

c) What is UJT ? What is the peak voltage of a UJT ? What is the valley point voltage of a UJT ? What is the intrinsic stand-off ratio of UJT ? What are the advantages of a PUT and a UJT ? 5 + 5 + 5

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

a) HVDC Transmission

b) SMPS

c) Speed control and braking of DC motor using chopper

d) Resonant Series Converter

e) Series and Parallel operation of SCRs.

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