

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (ECE-NEW)/SEM-6/EC-603/2010

2010

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 × 1 = 10

- i) The advantage of 180° conduction mode of three phase inverter circuit over 120° conduction mode is
- a) it needs less number of switches
 - b) there is no paralleling of switches
 - c) devices in series are not simultaneously switched
 - d) load terminals are not left open during switching.

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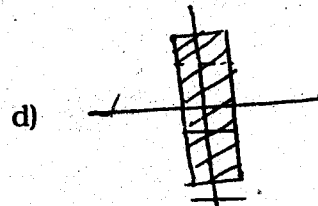
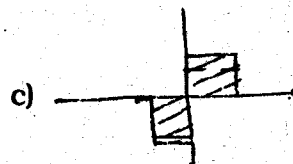
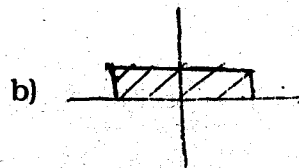
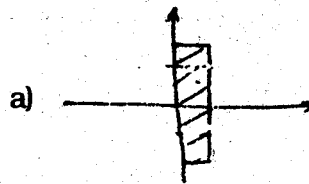
- ii) Chopper control of DC motors provides variations in
- a) input voltage b) frequency
 - c) current d) all of these.
- iii) In a controlled rectifier circuit, a free wheeling diode is not necessary if the load is
- a) inductive b) resistive
 - c) capacitive d) any of these.
- iv) Each SCR of a 3ϕ full-wave rectifier conducts for
- a) 60° b) 120°
 - c) 180° d) 90° .
- v) 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.

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- vi) In a 1-phase half-wave circuit with R-L load and a free wheeling diode across the load, extinction angle β is more than π . For a firing angle α , the SCR & free wheeling diode would conduct respectively, for
- a) $\pi - \alpha, \beta$ b) $\beta - \alpha, \pi - \alpha$
c) $\pi - \alpha, \beta - \pi$ d) $\pi - \alpha, \pi - \beta$
- vii) For a 1-phase two pulse controlled converter with a free wheeling diode across RL load, the instantaneous output voltage V_o
- a) is always positive
b) positive or zero
c) zero or negative
d) positive, negative or zero.
- viii) Resonant converters are basically used to
- a) generate large peak voltages
b) eliminate harmonics
c) reduce switching losses
d) convert a square wave into a sine wave.
- ix) The second breakdown phenomenon is exhibited by
- a) SCR b) Power MOSFET
c) GTO d) Power BJT.

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- x) If gate current of SCR is increased, then forward breakover voltage will
- a) increase b) decrease
- c) remain same d) become zero.
- xi) Semiconductor devices are mounted on heat sink for
- a) absorbing heat
- b) dissipating heat
- c) absorbing & dissipating heat
- d) thermal isolation.
- xii) The correct V - I diagram that covers the complete operation of a dual converter is



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GROUP - B**(Short Answer Type Questions)**Answer any *three* of the following. $3 \times 5 = 15$

2. With the help of relevant waveforms discuss the static & dynamic characteristics of SCR.
3. Draw a comparison between power transistor, power MOSFET & IGBT in relation to their application in power electronics.
4. Discuss what would happen if gate is made positive with respect to cathode during reverse blocking of an SCR.
5. Distinguish clearly the voltage & current communication in an SCR circuit.
6. Explain the effect of source inductor in the operation of a 3-phase full converter.

GROUP - C**(Long Answer Type Questions)**Answer any *three* of the following. $3 \times 15 = 45$

7.
 - a) What do you understand by a two pulse converter ?
 - b) Explain the operation of a single phase fully controlled bridge converter connected with $R - L$ load. Show the possible waveforms of the output voltage, SCR current & source current for a firing angle and considering ripple free output current.
 - c) Derive expressions for average & RMS value of output voltage for converter mentioned in (b).
 - d) A battery is charged by a fully controlled single phase converter. The input supply is 50V at 50 Hz. The load consists of a 30 V battery and a resistance of 5Ω connected in series to limit the current. What is the minimum possible firing angle ? Compute the value of average output voltage.

 $1 + 6 + 4 + 4$

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8. a) How is the working of a full bridge single phase inverter different from that of half bridge circuit ? Explain with the help of relevant diagram.
- b) A single phase half bridge inverter has a resistive load of 10Ω & centre tap dc input voltage of 96 volt. Compute —
- RMS value of the output voltage
 - fundamental component of output voltage waveform
 - first five harmonics of the output voltage
 - fundamental power consumed.
- c) What is zero voltage switching ? 4 + 8 + 3
9. a) Explain with a neat circuit diagram & relevant waveforms, the principle of operation of a boost converter.
- b) A boost converter has a supply voltage of 250 volt, while the output voltage is 500 V. If the period of converter is $100\ \mu\text{sec}$, determine the conduction of the switch. If the period is reduced to one third for constant frequency operation, find the output voltage.
- c) With a neat circuit diagram, explain the operation of CUK converter.
- d) State the advantages of CUK converter over Buck-Boost converter. 4 + 4 + 4 + 3

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10. a) What do you mean by series converter ? Explain its working with neat circuit diagram & relevant waveforms.
- b) Explain how zero voltage converter can be achieved in a series resonant converter.
- c) Mention merits of resonant converter over a conventional converter. $7 + 5 + 3$
11. Write short notes on any *three* of the following : 3×5
- a) UPS
- b) Induction heating
- c) Need for power electronic converters
- d) Electronic ballast.
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