

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech(EIE)/SEM-7/EE-701(EI)/2009-10**2009****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) A $1 - \phi$ full bridge inverter can operate in load commutation mode in case the load consists of

- | |
|--------------------------|
| a) RLC overdamped |
| b) RLC underdamped |
| c) RLC critically damped |
| d) RL. |

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- iii) In a thyristor, the magnitude of anode current will
- increase if gate current is increased
 - decrease if gate current is decreased
 - increase if gate current is decreased
 - remains unchanged with any variation in gate current.
- iv) A single phase full bridge VSI has inductive load. For a constant source, the current through the load is
- square wave
 - triangular wave
 - sine wave
 - pulsed wave (rectangular).
- v) In a 1 - ϕ full-converter, for discontinuous load current and extinction angle $\beta > \pi$, each SCR conducts for
- α
 - $\beta - \alpha$
 - β
 - $\beta + \alpha$
- vi) In an UJT the voltage across the two base terminals is V_{BB} , the diode voltage drop is V_D and η is the intrinsic stand-off ratio. The emitter potential at peak point is given as
- ηV_{BB}
 - ηV_D
 - $\eta V_{BB} + V_D$
 - $\eta V_D + V_{BB}$
- vii) When a power BJT is compared to power MOSFET,
- BJT has lower switching losses but higher conduction losses
 - BJT has higher switching losses but lower conduction losses
 - BJT has lower switching losses and conduction losses
 - BJT has higher switching losses and conduction losses.

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viii) In a single-pulse modulation of PWM inverters, third harmonic can be eliminated if pulse width is equal to

- a) 30° b) 60°
 c) 120° d) 15° .

ix) A cyclo-converter is a

- a) DC to AC converter
 b) Phase controlled converter
 c) DC to DC converter.
 d) Direct frequency changer.

x) Input voltage surge does not effect the critical load in

- a) On-line UPS b) Off-line UPS
 c) Normal UPS d) None of these.

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

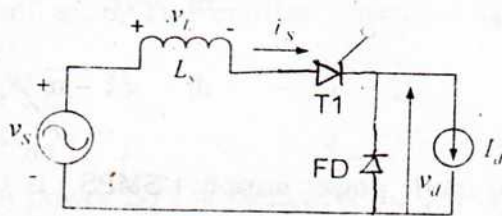
- a) αV_s b) $\sqrt{\alpha} V_s$ *
 c) $\frac{V_s}{\sqrt{\alpha}}$ d) $\sqrt{1 - \alpha} V_s$.

xii) Switched mode power supply (SMPS) is preferred over continuous types because SMPS

- a) are suitable for both AC and DC
 b) are suitable for low power circuits
 c) are 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. What is a Current Source Inverter ? Mention its merits & demerits compared to Voltage Source Inverter ? 5
3. What is meant by commutation ? Explain the method of complementary commutation. 5
4. A 1 - ϕ converter with a free-wheeling diode is supplied from a 120 V, 50 Hz supply with a source inductance of 0.33 mH. Assuming the load current is continuous at 4A, find the commutation angle for the transfer of current from a conducting thyristor to the commutation diode. Deduce the necessary theory. 5



5. Describe reverse recovery characteristics of power diode ? A diode has a reverse recovery time of 2.5 ms. If di/dt is 35 A/ms, find the peak reverse current. 3 + 2
6. Explain the characteristics of RCT. How does it differ from GTO. 4 + 1

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

7. 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 ($R = 10 \text{ ohm}$).

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

Find out at the following conditions :

- i) The firing angle
 - ii) The average output voltage
 - iii) The average current of each thyristor
 - iv) PIV requirement of each thyristor.
- c) What is inversion ? Explain how the above mentioned converter can act as rectifier and inverted ? $6 + 6 + 3$
8. a) What is a cyclo-converter ? Describe the operating principle of a $1 - \phi$ to $1 - \phi$ step-up cyclo-converter with the help of bridge type configuration. Illustrate your answer with appropriate circuit and waveforms. The conduction of various SCRs should also be indicated in the diagram.
- b) Draw the schematic circuit of a circulating current mode cyclo-converter and its operating waveforms.
- c) What are the merits and demerits of a cyclo-converter compared to a variable frequency *ac* motor drive.

 $7 + 4 + 4$

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9. a) Describe the construction of IGBT ?
- b) Explain its operation with the help of an equivalent circuit. State the advantages of IGBT.
- c) How an SCR differ from a Triac ? Explain the working principle of PUT and state one of its application.
- d) Draw and explain time phase triggering circuit of an SCR.
10. a) Draw the schematic circuit, the equivalent circuit for at least three modes of conduction, waveforms of gate pulses, phase voltages and line voltages of a three-phase inverter with 120° conduction. List the merits and demerits of this circuit compared to 120° conduction.
- b) Find the phase-to-neutral and line-to-line RMS output voltages for a three-phase 120° conduction inverter having a dc input of 50 V with pure resistive load.

2 + 4 + 6 + 3

9 + 6

11. Write short notes on any *three* the following :

3 × 5

- a) Use of cyclo-converter for effective speed control of 3-phase induction motor.
 - b) UPS
 - c) SMPS
 - d) Speed control and braking of DC motor using chopper
 - e) Block diagram of a drive module.
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