



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EEE/EE(O))/SEM-5/EE-504/2009-10  
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.*

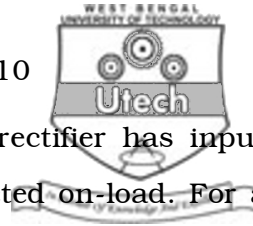
**GROUP – A**

**( Multiple Choice Type Questions )**

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

$$10 \times 1 = 10$$

- i) A triac is equivalent to
  - a) two thyristors in series
  - b) two thyristors in parallel
  - c) one thyristor and one diode
  - d) one thyristor and one transistor.
- ii) A single-phase full converter can operate in
  - a) 4 quadrants
  - b) 3 quadrants
  - c) 2 quadrants
  - d) 1 quadrant.



iii) A single-phase half-wave controlled rectifier has input voltage  $V_s = 400 \sin 314 t$  is connected on-load. For a triggering angle of  $60^\circ$  for SCR, the average output voltage is

- a)  $400 / \pi$                                       b)  $300 / \pi$
- c)  $240 / \pi$                                       d)  $200 / \pi$ .

iv) Natural commutation can be used in

- a) DC circuits only
- b) AC circuits only
- c) both AC and DC circuits
- d) none of these.

v) When a thyristor is conducting, the voltage drop across it

- a) is absolutely constant
- b) decreases with increase in load current
- c) increases slightly with increase in load current
- d) any of these.

vi) When a thyristor is conducting, the voltage drop across it is about

- a) 1 V    b) 10 V
- c) 100 V    d) 0.1 V.



vii) SCR can be used as

- a) amplifier
- b) switch
- c) both switch & amplifier
- d) none of these.

viii) Reverse recovery current in a diode depends upon

- a) forward field current
- b) storage charge
- c) temperature
- d) PIV.

ix) 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.



x) An UJT exhibits negative resistance region

- a) before the peak point
- b) between peak & valley points
- c) after the valley point
- d) both (a) & (c).

xi) In a thyristor anode current is made-up of

- a) Electron only
- b) Electrons & holes
- c) Holes only
- d) None of these.

### GROUP – B

#### ( Short Answer Type Questions )

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

- 2. Draw and explain dynamic switching characteristics of Thyristor. 5
- 3. 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



4. Distinguish clearly between voltage commutation and current commutation in an SCR circuit. 5
5. Explain the turn-off process of an SCR with the help of anode current versus time waveform. Define the turn-off time of an SCR and circuit turn-off time. 3 + 2
6. Explain with the help of circuit diagram, the principle of operation of step-up chopper. Deduce the expression of output voltage of such chopper. 3 + 2

### GROUP – C

#### ( Long Answer Type Questions )

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

7. a) Explain with appropriate waveforms, the different control strategies used for obtaining variable voltage from a *dc* chopper. Which one of these is preferred over the other and why ?
- b) Draw neatly the circuit diagram of a four quadrant chopper and explain its operation.
- c) For a type A chopper, *dc* source voltage = 230 V, load resistance = 10 Ω. Take a drop of 2 V across chopper when it is on. For a duty cycle of 0.4, calculate
  - i) average and rms values of output voltage
  - ii) chopper efficiency. 5 + 5 + 5



8. a) Discuss the principle of working of a 3-phase bridge inverter with an appropriate circuit diagram. Draw phase and line voltage waveforms on the assumption that each SCR conducts for  $180^\circ$  and the resistive load is star connected. The sequence of firing of various SCRs should also be indicated in the diagram.
- b) Explain how the voltage of a single-phase inverter is controlled by PWM techniques. 8 + 7
9. a) What is a cycloconverter ? What are the advantage it offers compared to an inverter.
- b) Explain with schematic diagram and necessary waveforms, the principle of operation of a single-phase step-up cycloconverter.
- c) What do you understand by blocked group operation and circulating current mode operation of a cycloconverter ? Explain. 5 + 5 + 5
10. Design the Snubber circuit parameters  $dv/dt$  protection of an SCR. Briefly describe the turn-on methods of SCR. What are the problems of parallel connected SCRs & what are the remedies ? 15



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

3 × 5

- a) Triggering methods of SCR
  - b) Step-up choppers
  - c) SMPS
  - d) PWM controlled inverter
  - e) MOSFET
  - f) UPS.
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