



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH(EE)/SEM-5/EE-504/2011-12**  
**2011**  
**POWER ELECTRONICS**

Time Allotted : 3 Hours

Full Marks : 70

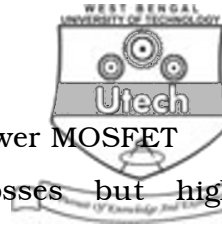
*The figures in the margin indicate full marks.*

*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) A power electronics device with highest frequency of operation is
    - a) IGBT
    - b) MOSFET
    - c) GTO
    - d) Thyristor.
  - ii) When UJT is used for triggering an SC, the wave shape of the voltage obtained from UJT circuit is
    - a) sine wave
    - b) trapezoidal wave
    - c) sawtooth wave
    - d) square wave.
  - iii) Presence of drift layer in a power semiconductor device
    - a) increases breakdown voltage rating
    - b) increases on state current rating
    - c) increases switching speed
    - d) decreases on state resistance.



- iv) When a power BJT is compared to power MOSFET
  - a) BJT has lower switching losses but higher conduction loss
  - b) BJT has higher switching losses but lower conduction loss
  - c) BJT has lower switching losses and conduction losses
  - d) BJT has higher switching losses and conduction losses.
- v) The ripple content of load current of a converter feeding RL load is decided by
  - a) load resistance alone
  - b) load inductance alone
  - c) both load resistance and load inductance
  - d) neither resistance nor inductance.
- vi) Latching current can be defined as
  - a) Minimum value of anode current to maintain continuous conduction
  - b) Maximum value of anode current to maintain continuous conduction
  - c) Minimum value of anode current below which SCR turns off
  - d) Maximum value of anode current above which the SCR turns off.
- vii) The TRIAC is equivalent to
  - a) Two SCRs in parallel
  - b) Two SCRs in antiparallel
  - c) One SCR & one diode connected in parallel
  - d) One SCR and one diode connected in antiparallel.



- viii) A single phase full converter can operate in
- 4 quadrants
  - 3 quadrants
  - 2 quadrants
  - 1 quadrant.
- ix) A current source inverter is normally employed
- if the source inductance is small
  - if the source inductance is large
  - on any source irrespective of its impedance
  - if the load is pure inductive load.
- x) In resonant pulse commutation
- the load current must be greater than peak value of peak resonant current
  - the load current must be equal to the peak value of resonant current
  - the peak value of resonant current must be greater than the load current
  - is always possible whatever be the value of resonant peak current compared to load current.
- xi) An IGBT has three terminals called
- collector, emitter and base
  - drain, source and base
  - drain, source and gate
  - collector, emitter and gate.
- xii) In a single phase half controlled rectifier with R-L load using flywheel diode, cathode of the flywheel diode is connected to
- anode of SCR
  - cathode of SCR
  - gate of SCR
  - across anode & cathode of SCR.

- ### GROUP – B

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

- 4



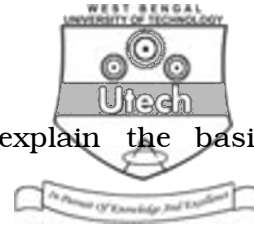
6. a) Draw the circuit diagram of a single phase full wave controlled rectifier with centre tap transformer & explain wave shape of load voltage, load current, voltage across  $Th_1$  &  $Th_2$  with firing angle at ' $\alpha$ '.
- b) Prove that  $E_{rms} = E_M \{ \{(\pi - \alpha) / 2\pi\} + \{(\sin 2\alpha / 4\pi)\} \}^{1/2}$

### GROUP – C

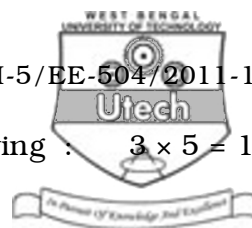
#### ( Long Answer Type Questions )

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

7. a) Draw and explain dynamic switching characteristics of Power BJT.
- 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 time phase triggering circuit of an SCR.  $2 + 4 + 6 + 3$
8. a) A dc battery is charged from a constant dc source of 220 V through a chopper. The dc battery is to be charged from its internal emf of 90 V to 122 V. The battery has internal resistance of 1 ohm. For a constant charging current of 10 A, calculate the range of duty cycle.



- b) With the help of block diagram explain the basic principle of operation of SMPS.
- c) Define an inverter. What are the different types of inverters ? 5 + 5 + 5
9. a) What is cycloconverter ? How is it advantageous over an inverter ?
- b) What do you mean by blocked group operation and circulating current mode operation of a cycloconverter ?
- c) Mention the applications of a cycloconverter. 5 + 7 + 3
10. a) Describe the working principle of three phase bridge inverter (VSI) operating in  $180^\circ$  mode. Draw the waveforms for output voltage (both phase & line voltage). Assume star connected balanced resistive load.
- b) A single phase bridge inverter delivers power to a series connected RLC load with  $R = 2.2 \Omega$  and  $\omega L = 10 \Omega$ . The periodic time  $T = 0.12$  msec. What value of  $C$  should the load have in order to obtain load commutation for the SCRs ? The thyristor turn-off time is  $10 \mu$  sec. Take circuit turn-off time as 1.6 times the thyristor turn off time. Assume load current contains only fundamental component. 10 + 5



11. Write short notes on any *three* of the following :  $3 \times 5 = 15$

- a) Power MOSFET
- b) IGBT
- c) Static Circuit Breaker
- d) Static Var Compensators
- e) UPS.

12. a) Explain different PWM methods to control output voltage of an inverter.

- b) Discuss constant ( $V/f$ ) method of speed control of an induction machine.  $10 + 5$

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