

**POWER ELECTRONICS & DRIVES  
(AEIE 3102)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group - A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) A thyristor (SCR) is a
    - (a) P-N-P device
    - (b) N-P-N device
    - (c) P-N-P-N device
    - (d) P-N device
  - (ii) Which of the following is not a current triggered device?
    - (a) thyristor
    - (b) BJT
    - (c) triac
    - (d) MOSFET
  - (iii) In forward blocking mode of SCR, the number of forward biased junction is
    - (a) 1
    - (b) 2
    - (c) 3
    - (d) 4
  - (iv) For an SCR in the reverse blocking mode, (practically)
    - (a) leakage current does not flow
    - (b) leakage current flows from anode to cathode
    - (c) leakage current flows from cathode to anode
    - (d) leakage current flows from gate to anode
  - (v) In a controlled rectifier a freewheeling diode is necessary if the load is
    - (a) inductive
    - (b) resistive
    - (c) capacitive
    - (d) all of these
  - (vi) By using a freewheeling diode (FD) in a rectifier with RL load, the power consumed by the load
    - (a) increases
    - (b) decreases
    - (c) is not affected
    - (d) decreases to zero
  - (vii) For a full wave bridge inverter, the output voltage ( $V_o$ )
    - (a)  $V_o = V_s/2$  for  $0 < t < T/2$
    - (b)  $V_o = V_s$  for  $0 < t < T/2$
    - (c)  $V_o = V_s$  for  $T/2 < t < T$
    - (d)  $V_o = -V_s$  for  $T/2 < t < 3T/2$

- (viii) A Schottky diode will have  
(a) a low on state voltage and a small recovery time  
(b) a low on state voltage and a high recovery time  
(c) a high on state voltage and a low recovery time  
(d) a high on state voltage and a high recovery time
- (ix) For a step down Cyclo-converter the correct relation between the frequencies of the source voltage & output voltage is:  
(a)  $f_o = f_s/2$             (b)  $f_o = f_s$             (c)  $f_o = 2f_s$             (d)  $f_o < f_s$
- (x) The power electronics devices have a very high efficiency because  
(a) cooling is very efficient  
(b) the devices traverse active region at high speed & stays at the two states, on and off  
(c) the devices never operate in active region  
(d) the devices always operate in the active region

### **Group - B**

2. (a) Describe the turn on and turn off switching characteristics of IGBT. Compare among power BJT, power MOSFET and IGBT.  
(b) Draw and explain the different modes of operation using static V-I characteristic of thyristor. What is the effect of gate current on these characteristics?  
**(4+2+2) + (2+2) = 12**
3. (a) Explain the constructional details of IGBT and characteristics.  
(b) Draw and explain dynamic switching characteristics of power BJT.  
**6 + 6 = 12**

### **Group - C**

4. (a) Give an expression for average voltage and average current of single phase Full Converter with R load.  
(b) Explain the operation of three phase fully controlled bridge converter with RL loads. Illustrate in detail with discontinuous conduction mode with associated waveforms.  
**4 + (4+4) = 12**
5. (a) Explain the operation of a single phase half wave converter for R-load with neat circuit diagram and necessary waveforms.  
(b) The single-phase half-wave controlled rectifier supplies a resistive load draws an average current of 1.62 A. If the converter is operated from a 240 V, 50 Hz supply and if the average value of the output voltage is 81V, calculate the following:  
(i) the firing angle  $\alpha$ , (ii) load resistance, (iii) the rms load voltage, (iv) the rms load current, (v) DC power and (vi) the ripple factor.  
**6 + (1+1+1+1+1+1) = 12**

**Group - D**

6. (a) What is duty cycle of a chopper? With neat diagram briefly explain the operation of a step down dc chopper.
- (b) Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle.

**(2+4) + (3+3) = 12**

7. (a) What is meant a series inverter? What is the condition to be satisfied in the selection of L and C in a series inverter? What are the applications of a series inverter?

- (b) Explain the operation of a parallel inverter and mention the merits.

**(2+2+2) + (3+3) = 12**

**Group - E**

8. (a) What is regenerative braking? Briefly explain the regenerative braking mode operation of chopper drives with suitable diagram.

- (b) What are the advantages of microprocessor based control of traction motors?

**(2+6) + 4 = 12**

9. (a) What is meant by V/F control? What are the advantages of V/F control?

- (b) What is meant by stator current control? What is brushless DC motor?

**(4+4) + (2+2) = 12**

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