POWER ELECTRONICS & DRIVES
(AEIE 3102)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is not a current triggered device?
(a) Thyristor (b) BJT
(c) Triac (d) MOSFET.

(ii) Which terminal does not belong to the SCR?
(a) Anode (b) Gate
(c) Base (d) Cathode.

(iii) In power electronics the solid state devices act as
(a) amplifiers (b) controlled resistors
(c) switches (d) none of (a), (b) & (c).

(iv) The average output voltage is maximum when SCR is triggered at ωt =
(a) π (b) 0 (c) π/2 (d) π/4.

(v) The minimum value of anode current below which it must fall to completely turn-off the device is called as the
(a) holding current value (b) latching current value
(c) switching current value (d) peak anode current value

(vi) The two transistor model of the SCR can obtained by
(a) bisecting the SCR vertically
(b) bisecting the SCR horizontally
(c) bisecting the SCRs top two & bottom two layers
(d) bisecting the SCRs middle two layers

(vii) The latching current is _____ the holding current.
(a) lower than (b) higher than
(c) same as (d) negative of

(viii) 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.

(ix) A single-phase half-wave thyristor circuit with R load is triggered at an angle of $\alpha = 0°$. As such, the maximum value of the average output voltage would be given by Consider $V_s = V_m \sin\omega t$.
(a) V_m (b) $2V_m/\pi$
(c) V_m/π (d) V_m/α

(x) 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.

Fill in the blanks with the correct word

(xi) A triac can pass a portion of _____ half-cycle through the load.

(xii) When the temperature increases, the inter-base resistance (RBB) of a UJT _____.

(xiii) A triac is equivalent to two SCRs _____.

(xiv) The device that does not have the gate terminal is _____.

(xv) A diac has _____ pn junctions.

Group - B

2. (a) What are the differences between power diode and signal diode? *[(CO1)(Analyse/HOCQ)]*

(b) Draw the basic structure of an IGBT and explain its operation. *[(CO1)(Remember /LOCQ)]*

(c) Compare the performance characteristics of MOSFET with BJT. *[(CO1)(Apply/IOCQ)]*

3 + 5 + 4 = 12

3. (a) Discuss the different modes of operation of thyristor with the help of its static V-I characteristics. *[(CO1)(Remember/LOCQ)]*

(b) Briefly discuss the Diode triggering of SCR. *[(CO1) (Remember/LOCQ)]*

(c) What is a Snubber circuit? *[(CO1)(Apply/IOCQ)]*

5 + 4 + 3 = 12

Group - C

4. (a) Derive the expressions for the following performance factors of single phase fully controlled bridge converter (i) input displacement factor,(ii) input power factor,(iii) voltage ripple factor,(iv) active power input and (v) Reactive power input. *[(CO2)(Analyse/HOCQ)]*

(b) What are the features of Half-controlled converters over full controlled converters? *[(CO2)(Remember/LOCQ)]*

(c) Mention some of the applications of controlled rectifiers. *[(CO2)(Apply/IOCQ)]*

5 + 4 + 3 = 12

5. (a) Give an expression for average voltage and average current of single phase Full Converter with R load. *[(CO2)(Analyse/HOCQ)]*

(b) What are the features of Half-controlled converters over full controlled converters? *[(CO2)(Remember/LOCQ)]*

(c) What is six pulse converter? Write its advantages. *[(CO3)(Apply/IOCQ)]*

3 + 4 + 5 = 12

Group - D

6. (a) Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. *[(CO4)(Analyse/HOCQ)]*

(b) What is meant by PWM control in dc chopper? *[(CO4)(Remember/LOCQ)]*

(c) What are the applications of dc chopper? *[(CO4)(Apply/IOCQ)]*

(3 + 3) + 3 + 3 = 12

7. (a) What is meant by inverter? *[(CO4)(Analyse/HOCQ)]*

(b) Describe the operation of basic series inverter. State its limitation. *[(CO4)(Remember/LOCQ)]*

(c) Compare CSI and VSI. *[(CO4)(Apply/IOCQ)]*

3 + (3 + 3) + 3 = 12

Group - E

8. (a) What is regenerative breaking? Briefly explain the regenerative breaking mode operation of chopper drives with suitable diagram. *[(CO5,CO6) (Analyse/HOCQ)]*

(b) Explain the different modes of operation of a TRIAC. *[(CO5,CO6)(Remember/LOCQ)]*

(c) What are the applications of TRIAC? *[(CO5,CO6)(Apply/IOCQ)]*

(3 + 4) + 3 + 2 = 12

9. (a) What is meant by rotor resistance control? *[(CO5) (CO6) Analyse/HOCQ)]*

(b) What are the advantages and disadvantages of rotor resistance control? *[(CO5) (CO6) (Remember/LOCQ)]*

(c) What is a brushless DC motor? *[(CO5) (CO6) (Remember/LOCQ)]*

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75	23.96	32.29

Course Outcome (CO):

After the completion of the course students will be able to

1. Gain knowledge on basic power electronics devices.
2. Describe single phase power converter circuits and understand their applications.
3. Analyze three phase power converter circuits and understand their applications.
4. Explain inverter, chopper circuits and list their industrial uses.
5. Understand the applications of AC and DC drives in industry.
6. Learn about power converters for sustainable energy technologies.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*