

[Question Bank]

LAB:

POWER ELECTRONICS

Code: ECE-452

Subject Teacher:

Er. Amandeep Singh
Bhandari

Semester VIIth

This booklet Includes:

- List of Equipments
- List of Softwares
- List of Experiments
- lab Manual
- Question Bank

ECE 452 POWER ELECTRONICS LAB

Quiz Questions with Answers

Experiment No. - 1

Aim: Study of SCR V-I Characteristics

Apparatus: SCR Characteristics Kit, Multimeter, Connecting Leads.

Question Bank:

1. A thyristor is turned on by applying a _____ gate current pulse when it is _____ biased.
2. Total turn on time of a thyristor can be divided into _____ time _____ time and _____ time.
3. During rise time the rate of rise of anode current should be limited to avoid creating local _____.
4. A thyristor can be turned off by bringing its anode current below _____ current and applying a reverse voltage across the device for duration larger than the _____ time of the device.
5. Reverse recovery charge of a thyristor depends on the _____ of the forward current just before turn off and its _____.
6. Inverter grade thyristors have _____ turn off time compared to a converter grade thyristor.
7. A thyristor is a _____ carrier semi controlled device.
8. A thyristor can conduct current in _____ direction and block voltage in _____ direction.
9. A thyristor can be turned ON by applying a forward voltage greater than forward _____ voltage or by injecting a positive _____ current pulse under forward bias condition.
10. To turn OFF a thyristor the anode current must be brought below _____ current and a reverse voltage must be applied for a time larger than _____ time of the device.
11. A thyristor may turn ON due to large forward _____.
12. Forward break over voltage of a thyristor decreases with increase in the _____ current.

13. Reverse _____ voltage of a thyristor is _____ of the gate current.
14. Reverse saturation current of a thyristor _____ with gate current.
15. In the pulsed gate current triggering of a thyristor the gate current pulse width should be larger than the _____ time of the device.
16. To prevent unwanted turn ON of a thyristor all spurious noise signals between the gate and the cathode must be less than the gate _____ voltage.
17. A thyristor is turned on by applying a _____ gate current pulse when it is _____ biased.
18. Total turn on time of a thyristor can be divided into _____ time _____ time and _____ time.
19. During rise time the rate of rise of anode current should be limited to avoid creating local _____.
20. A thyristor can be turned off by bringing its anode current below _____ current and applying a reverse voltage across the device for duration larger than the _____ time of the device.
21. Reverse recovery charge of a thyristor depends on the _____ of the forward current just before turn off and its _____.
22. Inverter grade thyristors have _____ turn off time compared to a converter grade thyristor.

Answer: (1) positive, forward; (2) delay, rise, spread; (3) hot spots (4) holding, turn off; (5) magnitude, rate of decrease (6) faster (7) minority; (8) one, both; (9) break over, gate; (10) holding, turn off; (11) dv/dt (12) gate; (13) break down, independent; (14) increases; (15) Turn ON; (16) non-trigger; (17) positive, forward; (18) delay, rise, spread; (19) hot spots (iv) holding, turn off; (20) magnitude, rate of decrease (21) faster

Experiment No. - 2

Aim: Study of SCR based single phase full wave fully controlled bridge rectifier

Apparatus: SCR based single phase full wave fully controlled bridge rectifier kit,
Connecting Leads, CRO, CRO probes.

Question Bank:

1. In a single phase fully controlled converter the _____ of uncontrolled converters are replaced by _____.
2. In a fully controlled converter the load voltage is controlled by controlling the _____ of the converter.
3. A single phase half wave controlled converter always operates in the _____ conduction mode.
4. The voltage form factor of a single phase fully controlled half wave converter with a resistive inductive load is _____ compared to the same converter with a resistive load.
5. The load current form factor of a single phase fully controlled half wave converter with a resistive inductive load is _____ compared to the same converter with a resistive load.
6. A single phase fully controlled bridge converter can operate either in the _____ or _____ conduction mode.
7. In the continuous conduction mode at least _____ thyristors conduct at all times.
8. In the continuous conduction mode the output voltage waveform does not depend on the _____ parameters.
9. The minimum frequency of the output voltage harmonic in a single phase fully controlled bridge converter is _____ the input supply frequency.
10. The input displacement factor of a single phase fully controlled bridge converter in the continuous conduction mode is equal to the cosine of the _____ angle.
11. The output voltage form factor of a single phase full wave rectifier is _____.
12. The output voltage of a single phase full wave rectifier supplying an inductive load is _____ of the load parameters.
13. The peak to peak output voltage ripple of a single phase split supply full wave rectifier supplying a capacitive load is _____ compared to an equivalent half wave rectifier.

14. The average output voltage of a full wave bridge rectifier and a split supply full wave rectifier are _____ provided the input voltages are _____.
15. For the same input voltage the bridge rectifier uses _____ the number of diodes used in a split supply rectifier with _____ the PIV rating.
16. For continuous conduction, the load impedance of a bridge rectifier should be _____.
17. In the _____ conduction mode the output voltage of a bridge rectifier is _____ of load parameters.

Answer: 1. diodes, thyristors; 2. firing angle; 3. discontinuous 4. poorer; 5. better; 6. continuous, discontinuous; 7. two; 8. load; 9. twice; 10. Firing; 11. $\pi/2\sqrt{2}$; 12. independent; 13. Smaller; 14. equal, equal; 15. double, half; 16. inductive; 17. continuous, independent.

1. What is meant by delay angle?

The delay angle is defined as the angle between the zero crossing of the input voltage and the instant the thyristors is fired.

2. What are the advantages of single phase bridge converter over single phase midpoint converter?

- (a) SCRs are subjected to a peak-inverse voltage of $2V_m$ in a fully controlled bridge rectifier. Hence for same voltage and current ratings of SCRs, power handled by mid-point configuration is about
- (b) In mid-point converter, each secondary winding should be able to supply the load power. As such, the transformer rating in mid-point converter is double the load rating.

Experiment No. 3**Aim: Study of UJT characteristics and use as relaxation oscillator.****Apparatus: UJT as relaxation oscillator kit, CRO, Connecting Leads, CRO Probes.****Question Bank:**

1. In an UJT, with V_{BB} as the voltage across two base terminals, the emitter potential at peak point is given by

- (a) ηV_{BB} (b) ηV_D
 (c) $\eta V_{BB} + V_D$ (d) $\eta V_D + V_{BB}$

2. An UJT exhibits negative resistance region

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

3. In an UJT, maximum value of charging resistance is associated with

- (a) peak point (b) valley point
 (c) any point between peak and valley points (d) after the valley point.

4. When an UJT is used for triggering an SCR, the waveshape of the voltage obtained from UJT circuit is a

- (a) sine wave (b) saw-tooth wave
 (c) trapezoidal wave (d) square wave.

5. For an UJT employed for the triggering of an SCR, stand-off ratio $\eta = 0.64$ and dc source voltage V_{BB} is 20 V. The UJT would trigger when the emitter voltage is

- (a) 12.8 V (b) 13.5 V (c) 10 V (d) 5 V

6. UJTs are used for oscillators for the existence of

- (a) peak-point potential (b) valley-point potential
 (c) positive resistance part of VA characteristics (d) negative resistance part of VA characteristics.

7. An UJT is employed to fabricate a relaxation oscillator. When energised, it fails to oscillate. This may be due to

1. high base-terminal voltage V_{BB}
2. too large a capacitor
3. low value of charging resistor
4. large interbase resistance.

From these, the correct statements are

- (a) 1, 3 (b) 1, 2,3 (c) all (d) 2, 4

Answers: 1. (c) 2. (b) 3. (a) 4. (b) 5. (b) 6. (d)
7. (a)

Experiment No. – 4

Aim: Study of SCR based chopper circuit

Apparatus:

Question Bank:

1. In dc choppers, if T_{on} is the on-period and f is the chopping frequency, then output voltage in terms of input voltage V_s is given by

- (a) $V_s \cdot T_{on}/f$ (b) $V_s \cdot f/T_{on}$ (c) $V_s/f \cdot T_{on}$ (d) $V_s \cdot f \cdot T_{on}$

2. In dc choppers, the waveforms for input and output voltages are respectively

- (a) discontinuous, continuous (b) both continuous
(c) both discontinuous (d) continuous, discontinuous.

3. A chopper can be used on

- (a) pulse-width modulation only (b) frequency modulation only
(c) amplitude modulation only (d) both PWM and FM

4. In PWM method of controlling the average output voltage in a chopper,

1. on-time T_{on} is varied and chopping frequency f is kept constant
2. T_{on} is kept constant and f is varied
3. both T_{on} and off-time T_{off} are varied and f is kept constant
4. T_{off} is varied and T is kept constant.

From above, the correct statements are

- (a) 1, 3 (b) 1,3, 4 (c) 2, 3, 4 (d) 3, 4

Dept. of Electronics and Communicaton Engineering, Punjabi University, Patiala

Designed By : Er. Manbir Singh Shergill

5. In FM method of controlling the average output voltage in a chopper,

1. on-time T_{on} is kept constant and chopping period T is varied
2. turn-off time T_{off} is kept constant and T is varied
3. T_{on} is kept constant and T_{off} is varied
4. T_{off} is kept constant and T_{on} is varied

From these the correct statements are

- (a) 1,3,4 (b) 2,3,4 (c) 1,2,3,4 (d) 1,2,3

6. A chopper has V_s as the source voltage, R as the load resistance and α as the duty cycle. For this chopper, rms value of output voltage is

- (a) αV_s (b) $\alpha^{1/2} \cdot V_s$ (c) $V_s / \alpha^{1/2}$ (d) $(1 - \alpha)^{1/2} \cdot V_s$

7. In dc choppers, per unit ripple is maximum when duty cycle α is

- (a) 0.2 (b) 0.5
(c) 0.7 (d) 0.9

8. A chopper, where voltage as well as current remain negative, is known as

- (a) type-A (b) type-B
(c) type-C (d) type-D

9. A chopper, in which current remains positive but voltage may be positive or negative, is known as

- (a) type-A (b) type-B
(c) type-C (d) type-D

10. A dc chopper is fed from constant voltage mains. The duty ratio α of the chopper is progressively increased while the chopper feeds RL load. The per unit current ripple would

- (a) increase progressively
(b) decrease progressively
(c) decrease to a minimum value at $\alpha = 0.5$ and then increase
(d) increase to a maximum value at $\alpha = 0.5$ and then decrease

11. In a two-quadrant dc to dc chopper, the load voltage is varied from positive maximum to negative maximum by varying the time-ratio of the chopper from

- (a) zero to unity (b) unity to zero
(c) zero to 0.5 (d) 0.5 to zero

Dept. of Electronics and Communicaton Engineering, Punjabi University, Patiala

Designed By : Er. Manbir Singh Shergill

12. For eliminating fifth harmonic from the output voltage wave of a dc chopper, the ripple factor should be

- (a) 1 (b) 2 (c) 3 (d) 4

13. In a chopper, for eliminating third harmonic from the output voltage wave, the duty cycle should be equal to

- (a) 1/5 (b) 1/4 (c) 1/3 (d) 1/2

- Answers:** 1. (d) 2. (d) 3. (d) 4. (b) 5. (c) 6. (b)
7. (b) 8. (b) 9. (d) 10. (d) 11. (b) 12. (b)
13. (c)



Experiment No. – 5

Aim: Study of Series commutated SCR inverter

Apparatus: Series commutated SCR inverter kit, CRO, Connecting Leads, CRO Probes.

Question Bank:

1. A series capacitor commutated inverter can operate satisfactorily if

(a) $\frac{1}{LC} > \frac{R^2}{4L^2}$ (b) $\frac{1}{LC} = \left(\frac{R}{2L}\right)^2$ (c) $\frac{1}{LC} < \frac{R^2}{4L^2}$

(d) irrespective of the values of R, L and C

2. If, for a single-phase half-bridge inverter, the amplitude of output voltage is V_s and the output power is P , then their corresponding values for a single-phase full-bridge inverter are

(a) V_s, P (b) $2V_s, P$ (c) $2 V_s, 2P$ (d) $2 V_s, 4P$

3. In voltage source inverters

- (a) load voltage waveform v_o depends on load impedance Z , whereas load current waveform i_o does not depend on Z
 (b) Both v_o and i_o depend on Z
 (c) v_o does not depend on Z whereas i_o depends on Z
 (d) both v_o and i_o do not depend upon Z .

4. A single-phase full bridge inverter can operate in load-commutation mode in case load consists of

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

5. Which of the following statement/statements is/are correct in connection with inverters:

- (a) VSI and CSI both require feedback diodes
 (b) Only CSI requires feedback diodes
 (c) GTOs can be used in CSI
 (d) Only VSI requires feedback diodes

6. In a CSI, if frequency of output voltage is f Hz, then frequency of voltage input to CSI is

- (a) f (b) $2f$ (c) $f/2$ (d) $3f$

Dept. of Electronics and Communicaton Engineering, Punjabi University, Patiala

Designed By : Er. Manbir Singh Shergill

7. A single-phase CSI has capacitor C as the load. For a constant source current, the voltage across the capacitor is

- (a) square wave (b) triangular wave
(c) step function (d) pulsed wave

8. A single-phase full bridge VSI has inductor L as the load. For a constant source voltage, the current through the inductor is

- (a) square wave (b) triangular wave
(c) sine wave (d) pulsed wave.

9. A VSI will have better performance if its

- (a) load inductance is small and source inductance is large
(b) both load inductance and source inductance are small
(c) both load inductance and source inductance are large
(d) load inductance is large and source inductance is small.

10. In a series resonant inverter

- (a) the load current has square waveform
(b) trigger frequency is higher than damped resonant frequency
(c) change of frequency does not alter transferred power
(d) output voltage depends upon damping factor of the load

Answers: 1. (a) 2. (d) 3. (c) 4. (b) 5. (d) 6. (b)

7. (b) 8. (b) 9. (b) 10. (d)

PUNJABI UNIVERSITY PATIALA

Experiment No. – 6**Aim: Study of SCR based parallel inverter****Apparatus: SCR based parallel inverter kit, CRO, Connecting Leads, CRO Probes****Question Bank:**

1. What is parallel inverter? Why is it called so?
2. What is the purpose of capacitor in the parallel inverter?
3. What is the purpose of transformer in the parallel inverter?
4. IS the parallel inverter naturally commutated or force commutated?
5. What are the advantages of parallel resonant inverters?
6. What is the purpose of the inductor in the parallel inverter?
7. During its operation, capacitor voltage reaches 2Vs. How?
8. What is the significance of the split phase transformer?
9. During operation, what is the voltage across primary winding of the transformer?
10. Capacitor current flows in how many modes of the operation of parallel inverter?



Experiment No. – 8**Aim: Study of Triggering circuits for SCR.**

Apparatus: SCR Triggering circuits kit, Connecting Leads, CRO, CRO probes, Multimeter.

Question Bank:

1. A thyristor is turned on by applying a _____ gate current pulse when it is _____ biased.
2. Total turn on time of a thyristor can be divided into _____ time _____ time and _____ time.
3. During rise time the rate of rise of anode current should be limited to avoid creating local _____.
4. A thyristor can be turned off by bringing its anode current below _____ current and applying a reverse voltage across the device for duration larger than the _____ time of the device.
5. Reverse recovery charge of a thyristor depends on the _____ of the forward current just before turn off and its _____.
6. Inverter grade thyristors have _____ turn off time compared to a converter grade thyristor.

Answer: (1) positive, forward; (2) delay, rise, spread; (3) hot spots (4) holding, turn off; (5) magnitude, rate of decrease (6) faster

1. UJT triggering circuit is also known as?
2. Types of triggering circuit?
3. What is the purpose of series resistor?
4. What is the condition for triggering the circuit?
5. What is the function of pulse transformer in firing circuit?

Experiment No. – 9

Aim: Study of Single phase half wave controlled converter

Apparatus: Single phase half wave controlled converter kit, Connecting Leads, CRO, CRO Probes.

Question Bank:

1. In a rectifier, electrical power flows from the _____ side to the _____ side.
2. Uncontrolled rectifiers employ _____ whereas controlled rectifiers employ _____ in their circuits.
3. For any waveform “Form factor” is always _____ than or equal to unity.
4. The minimum frequency of the harmonic content in the Fourier series expression of the output voltage of a rectifier is equal to its _____.
5. “THD” is the specification used to describe the quality of _____ waveforms where as “Ripple factor” serves the same purpose for _____ for waveforms.
6. Input “power factor” of a rectifier is given by the product of the _____ factor and the _____ factor.
7. The sum of “firing angle”, “Extinction angle” and “overlap angle” of a controlled rectifier is always equal to _____.
8. The ripple factor of the output voltage and current waveforms of a single phase uncontrolled half wave rectifier is _____ than unity.
9. With an inductive load, the ripple factor of the output _____ of the half wave rectifier improves but that of the output _____ becomes poorer.
10. In both single phase half wave and full wave rectifiers the form factor of the output voltage approaches _____ with capacitive loads provided the capacitance is _____ enough.
11. The PIV rating of the rectifier diode used in a single phase half wave rectifier supplying a capacitive load is approximately _____ the _____ input supply voltage.
12. The % THD of the input current of the rectifiers supplying capacitive loads is _____.
13. In a half controlled converter two _____ of a fully controlled converter are replaced by two _____.
14. Depending on the positions of the _____ the half controlled converter can have _____ different circuit topologies.
15. The input/output waveforms of the two different circuit topologies of a half controlled converter are _____ while the device ratings are _____.

16. A half controlled converter has better output voltage _____ compared to a fully controlled converter.
17. A half controlled converter has improved input _____ compared to a fully controlled converter.
18. In a half controlled converter the output voltage can not become _____ and hence it can not operate in the _____ mode.
19. For the same firing angle and input voltage the half controlled converter gives _____ output voltage form factor compared to a fully controlled converter.
20. For ripple-free continuous output current the input current displacement factor of a half controlled converter is given by _____.
21. For the same supply and load parameters the output current form factor of a half controlled converter is _____ compared to a fully controlled converter.
22. The free-wheeling operating mode of a half controlled converter helps to make the output current _____.

Answers: 1. ac, dc; 2. diodes, thyristors; 3. greater; 4. pulse number; 5. ac, dc; 6. displacement, distortion; 7. π ; 8. greater; 9. current, voltage; 10. unity, large; 11. double, peak; 12. High; 13. thyristors, diodes; 14. diodes, two; 15. same, different; 16. form factor; 17. power factor; 18. negative, inverter; 19. lower; 20. $\cos\pi/2$; 21. lower; 22. continuous.

PUNJABI UNIVERSITY PATIALA

Experiment No. – 10

Aim: Study of AC phase control using TRIAC (half & full wave)

Question Bank:

1. A Triac is a _____ minority carrier device
2. A Triac behaves like two _____ connected thyristors.
3. The gate sensitivity of a triac is maximum when the gate is _____ with respect to MT_1 while MT_2 is positive with respect to MT_1 or the gate is _____ with respect to MT_1 while MT_2 is negative with respect to MT_1
4. A Triac operates either in the _____ or the _____ quadrant of the I-V characteristics.
5. In the _____ quadrant the Triac is fired with _____ gate current while in the _____ quadrant the gate current should be _____.
6. The maximum possible voltage and current rating of a Triac is considerably _____ compared to thyristor due to _____ of the two current carrying paths inside the structure of the Triac.
7. To avoid unwanted turn on of a Triac due to large dv/dt _____ are used across Triacs.
8. For “clean turn ON” of a Triac the _____ of the gate current pulse should be as _____ as possible.

Answer: (1) bidirectional; (2) anti parallel; (3) positive, negative; (4) first, third; (5) first, positive, third, negative (6) lower, interaction; (7) R-C shubbers; (8) rise time, small.

PUNJABI UNIVERSITY PATIALA

Experiment No. – 12

Aim: Study of Current commutated thyristorised chopper.

Apparatus: Current commutated thyristorised chopper kit, CRO, Connecting Leads, CRO Probes.

Question Bank:

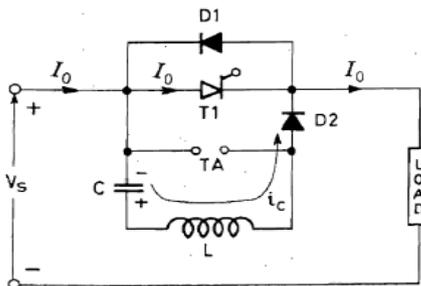
1. What is meant by current commutation?

In this process, a current pulse is made to flow in the reverse direction through the conducting thyristor and when the net thyristor current becomes zero, it is turned off.

2. What are the advantages of current commutated chopper?

- The capacitor always remains charged with the correct polarity.
- Commutation is reliable as load current is less than the peak commutation current ICP.
- The auxiliary thyristor TA is naturally commutated as its current passes through zero value.

1. In the current-commutated chopper shown in fig., thyristor T1 is conducting a load current I_o , When thyristor TA is turned on, with capacitor polarity as shown, the



capacitor current i_c would flow through.

- diode D1 because it provides an easy path.
- thyristor T1 because it is already conducting V_s
- diode D1 because thyristor T1 is unidirectional device and therefore current i_c cannot flow from cathode to anode
- SCR T1 because diode D1 is reverse biased by voltage drop across T1.

Ans: (d)

2. The process of commutating a SCR by applying a reverse voltage to an SCR through a previously charged capacitor is called as

- capacitor commutation
- forced commutation
- voltage commutation
- current commutation

Ans: (c)

Dept. of Electronics and Communicaton Engineering, Punjabi University, Patiala

Designed By : Er. Manbir Singh Shergill

3. In case of current commutation of SCR
- a diode is connected in series with the main SCR
 - a diode is connected in parallel with the main SCR
 - a diode is connected in anti-parallel with the main SCR
 - none of the mentioned

Ans: (c)

Experiment No. – 13

Aim: Study of Voltage commutated thyristorised chopper

Apparatus: Voltage commutated thyristorised chopper kit, CRO, Connecting leads, CRO

Probes.

Question Bank:

1. A voltage commutated chopper has the following parameters:

$V_s = 200$ V, Load circuit parameter: $1\ \Omega$, 2 mH, 50 V
Commutation circuit parameters, $L = 25\ \mu\text{H}$, $C = 50\ \mu\text{F}$

$T_{on} = 500\ \mu\text{s}$, $T = 2000\ \mu\text{s}$

For a constant load current of 100 A, the effective on period and peak current through the main thyristor are respectively

- | | |
|--|---|
| (a) $1000\ \mu\text{s}$, 200A | (b) $700\ \mu\text{s}$, $382.8\ \text{A}$ |
| (c) $700\ \mu\text{s}$, $282.8\ \text{A}$ | (d) $1000\ \mu\text{s}$, $382.8\ \text{A}$ |

2. For the voltage-commutated chopper of Prob. 1, the turn-off times for main and auxiliary thyristors are, respectively,

- | | |
|--|---|
| (a) $120\ \mu\text{s}$, $60\ \mu\text{s}$ | (b) $100\ \mu\text{s}$, $0.5\ \mu\text{s}$ |
| (c) $120\ \mu\text{s}$, $55\ \mu\text{s}$ | (d) $100\ \mu\text{s}$, $55.54\ \mu\text{s}$ |

3. The effective on period in a voltage commutated chopper

- increases with load current I_0 as well as with the commutating capacitance C
- decreases with I_0 as well as C
- decreases with I_0 but increases with C
- increases with I_0 but decreases with C

Answers: 1. (b) 2. (d) 3. (c)

Experiment No. – 14**Aim: Study of Fan regulator using DIAC and TRIAC**

Apparatus: Fan regulator using DIAC and TRIAC kit, Connection Leads, Multimeter, Tachometer

Question Bank:

1. A TRIAC is equivalent to

- (a) two diodes in antiparallel (b) one thyristor and one diode in parallel
(c) two thyristors in parallel (d) two thyristors in antiparallel

2. For a TRIAC and SCR,

- (a) both are unidirectional devices
(b) TRIAC requires more current for turn-on than SCR at a particular voltage
(c) a TRIAC has less time for turn-off than SCR
(d) both are available with comparable voltage and current ratings.

3. Consider the following statements:

1. The TRIAC is a five-layer device
2. The TRIAC may be considered to consist of two parallel sections $p1\ n1\ p2\ n2$ and $p2\ n1\ p1\ n4$
3. An additional latera region serves as the control, gate
4. The TRIAC is a double ended SCR.

From above, the correct statements are

- (a) all (b) 1,2,3
(c) 1 only (d) 1,4

4. TRIACs are most suit able when the supply voltage is

- (a) dc (b) low-frequency ac
(c) high-frequency ac (d) full-wave rectified ac

5. Which one of the following statements is correct? A TRIAC is a

- (a) 2 terminal switch
(b) 2 terminal bilateral switch
(c) 3 terminal unilateral switch
(d) 3 terminal bidirectional switch

Answers: 1. (d) 2. (b) 3. (a) 4. (b) 5. (d)

Experiment No. – 16**Aim: Study of Thyristor circuit breaker with current limiting****Apparatus: Thyristor circuit breaker with current limiting kit, Multimeter, Connecting Leads.****Question Bank:****1.** A circuit breaker is

- (A) power factor correcting device
- (B) a device to neutralize the effect of transients
- (C) a waveform correcting device
- (D) a current interrupting device.

Ans: (d)

2. The function of protective relay in a circuit breaker is

- (A) to detect any stray voltages
- (B) to close the contacts when the actuating quantity reaches a certain predetermined value
- (C) to limit arcing current during the operation of circuit breaker
- (D) to provide additional safety in the operation of circuit breaker.

Ans: (b)

3. Low voltage circuit breakers have rated voltage of less than

- (A) 220 V
- (B) 400V
- (C) 1000 V
- (D) 10,000 V.

Ans: (c)

4. The fault clearing time of a circuit breaker is usually

- (A) few minutes
- (B) few seconds
- (C) one second
- (D) few cycles of supply voltage.

Ans: (d)

5. The medium employed for extinction of arc in air circuit breaker is

- (A) SF₆
- (B) Oil
- (C) Air
- (D) Water

Ans: (c)

6. Which of the following circuit breakers is preferred for EHT application

- (A) Air blast circuit breakers
- (B) Minimum oil circuit breakers
- (C) Bulk oil circuit breakers
- (D) SF₆ oil circuit breakers.

Ans: (d)

7. For high voltage, ac circuit breakers, the rated short circuit current is passed for

- (A) 0.01 sec
- (B) 0.1 sec
- (C) 3 seconds
- (D) 30 seconds.

Ans: (c)



Experiment No. – 17

Aim: Study of SCR commutation methods class A-E

Apparatus: SCR commutation methods class A-E kit, Connecting Leads

Question Bank:

1. **What is meant by commutation?**

It is the process of changing the direction of current flow in a particular path of the circuit. This process is used in thyristors for turning it off.

2. **What are the types of commutation?**

- a. Natural commutation
- b. Forced commutation

3. **What is meant by natural commutation?**

Here the current flowing through the thyristor goes through a natural zero and enable the thyristor to turn off.

4. **What is meant by forced commutation?**

In this commutation, the current flowing through the thyristor is forced to become zero by external circuitry.

1. Match the type of commutation in List I with their alternative names in List II and tick the correct answer from the codes given below:

List I	List II
Type of commutation	Alternative title
A. Class A B. Class B C. Class C D. Class D	1. Voltage commutation 2. Parallel-capacitor commutation 3. Complementary-impulse commutation 4. Self-commutation 5. Natural commutation 6. Current commutation

Codes:

- | | |
|-------------|-------------|
| A B C D | A B C D |
| (a) 4 6 3 1 | (b) 5 1 4 6 |
| (c) 4 6 3 2 | (d) 4 6 2 4 |

2. Match the type of commutation in List I with those in List II and give the correct answer by using the codes given below the lists:

List I	List II
Type of commutation	Alternative title
A. Load commutation	1. Voltage commutation
B. Impulse commutation	2. Natural commutation
C. Line commutation	3. Resonant commutation
D. Resonant-pulse commutation	4. Parallel-capacitor commutation
	5. Current commutation

Codes:

A B C D	A B C D
(a) 5 1 2 3	(b) 2 4 3 5
(c) 3 4 2 5	(d) 3 1 2 4

3. In a commutation circuit employed to turn-off an SCR, satisfactory turn-off is obtained when

- (a) circuit turn-off time < device turn-off time
 (b) circuit turn-off time > device turn-off time
 (c) circuit time constant > device turn-off time
 (d) circuit time constant < device turn-off time

Answers: 1. (a) 2. (c) 3. (b)

Experiment No. – 18

Aim: Study of DC to DC converter

Apparatus: DC to DC converter kit, CRO, Connecting Leads, CRO Probes

Question Bank:

1. In the _____ type of chopper, two stage conversions takes place.

- a) AC-DC
 b) AC link
 c) DC link
 d) None of the mentioned

Answer: In AC link chopper, DC is converter to AC than stepped up/down than again AC to DC conversation takes place.

2. Choppers converter

- a) AC to DC
- b) DC to AC
- c) DC to DC
- d) AC to AC

Answer: c

Explanation: Choppers are used to step up or step down DC voltage/current levels. Hence, they are DC to DC converters.

3. A chopper may be thought as a

- a) Inverter with DC input
- b) DC equivalent of an AC transformer
- c) Diode rectifier
- d) DC equivalent of an induction motor

View Answer

Answer: b

Explanation: It is a DC equivalent of an AC transformer because it behaves in the similar manner i.e. converting fixed DC to variable DC.

4. Which device can be used in a chopper circuit?

- a) BJT
- b) MOSFET
- c) GTO
- d) All of the mentioned

View Answer

Answer: d

Explanation: All of the devices which can be used as a switch can be used in a chopper.

5. A chopper is a

- a) Time ratio controller
- b) AC to DC converter
- c) DC transformer
- d) High speed semiconductor switch

Answer: d

Explanation: It is a high speed on/off semiconductor switch. Note that it behaves like a DC transformer, does not mean it is a DC transformer. There is no DC transformer.

6. What is the duty cycle of a chopper ?

- a) T_{on}/T_{off}
- b) T_{on}/T
- c) T/T_{on}
- d) $T_{off} \times T_{on}$

View Answer

Answer: b

Explanation: It is the time during which the chopper is on (T_{on}) relative to the whole period ($T = T_{on} + T_{off}$).

7. The load voltage of a chopper can be controlled by varying the

- a) duty cycle
- b) firing angle
- c) reactor position
- d) extinction angle

View Answer

Answer: a

Explanation: The output voltage can be changed by changing the duty cycle (T_{on}/T).

8. The values of duty cycle (α) lies between

- a) $0 < \alpha < 1$
- b) $0 > \alpha > -1$
- c) $0 \leq \alpha \leq 1$
- d) $1 < \alpha < 100$

View Answer

Answer: c

Explanation: The duty cycle is between 0 and 1. It can be 0 if the chopper switch is never on and it can be 1 when the chopper switch is always on.

9. If T is the time period for a chopper circuit and α is its duty cycle, then the chopping frequency is

- a) T_{on}/α
- b) T_{off}/α
- c) α/T_{off}
- d) α/T_{on}

View Answer

Answer: d

Explanation: $\alpha = T_{on}/T$

$T = T_{on}/\alpha$

$f = 1/T = \alpha/T_{on}$.

10. Find the output voltage expression for a step down chopper with V_s as the input voltage and α as the duty cycle.

- a) $V_o = V_s/\alpha$
- b) $V_o = V_s \times \alpha$
- c) $V_o = V_s^2/\alpha$
- d) $V_o = 2V_s/\alpha\pi$

View Answer

Answer: b

Explanation: The chopper output voltage is Duty cycle x the input voltage (ideal condition).

1. What is meant by dc chopper?

A dc chopper is a high speed static switch used to obtain variable dc voltage from a constant dc voltage.

2. What are the applications of dc chopper?

- a. Battery operated vehicles
- b. Traction motor control in electric traction
- c. Trolley cars
- d. Marine hoists
- e. Mine haulers
- f. Electric braking.

3. What are the advantages of dc chopper?

Chopper provides

- a. High efficiency
- b. Smooth acceleration
- c. Fast dynamic response
- d. Regeneration

4. What is meant by step-up and step-down chopper?

In a step- down chopper or Buck converter, the average output voltage is less than the input voltage.

In a step- up chopper or Boost converter, the average output voltage is more than the input voltage.

5. What is meant by duty-cycle?

Duty cycle is defined as the ratio of the on time of the chopper to the total time period of the chopper. It is denoted by α .

6. What are the two types of control strategies?

- Time Ratio Control (TRC)
- Current Limit Control method (CLC)

7. What is meant by TRC?

In TRC, the value of T_{on} / T is varied in order to change the average output voltage.

8. What are the two types of TRC?

- Constant frequency control
- Variable frequency control

9. What is meant by FM control in a dc chopper?

In frequency modulation control, the chopping frequency f (or the chopping period T) is varied. Here two controls are possible.

- On-time T_{on} is kept constant
- Off period T_{off} is kept constant.

10. What is meant by PWM control in dc chopper?

In this control method, the on time T_{on} is varied but chopping frequency is kept constant. The width of the pulse is varied and hence this type of control is known as Pulse Width Modulation (PWM).

Experiment No. – 19**Aim: Study of DC Motor speed control using SCR's.****Apparatus:****Question Bank:**

1. A separately-excited dc motor is required to be controlled from a 3-phase source for operation in the first quadrant only. The most preferred converter would be

- (a) fully-controlled converter
- (b) fully-controlled converter with freewheeling diode
- (c) half-controlled converter
- (d) sequential control of two series connected fully-controlled converters

Ans: (c)

2. A separately-excited dc motor, when fed from 1-phase full converter with firing angle α , runs at a speed of N rpm. When this motor is fed from 1-phase semiconverter but with the same firing angle as for full-converter, the motor speed is found to be 2N rpm. The value of firing angle is

- (a) 70.528°
- (b) 75.572°
- (c) 70°
- (d) 69.88°

Ans: (a)

3. A separately-excited dc motor, when fed from 1-phase full converter with firing angle 60° runs at 1000 rpm. If this motor is connected to 1-phase semiconverter with the same firing angle of 60° , the motor would now run at

- (a) 2000 rpm
- (b) 1500 rpm
- (c) 1450 rpm
- (d) 1000 rpm

Ans: (b)

4. A separately-excited dc motor, when fed from 1-phase full converter, runs at a speed of 1200 rpm. Load current remains continuous. If one of the four SCRs gets open-circuited, the motor speed will reduce to

- (a) 900 rpm
- (b) 800 rpm
- (c) 600 rpm
- (d) 400 rpm

Ans: (c)

Experiment No. – 21**Aim: Study of Single phase cyclo-converter****1. What is meant by cyclo-converter?**

It converts input power at one frequency to output power at another frequency with one-stage conversion. Cyclo-converter is also known as frequency changer.

2. What are the two types of cyclo-converters?

- a. Step-up cyclo-converters
- b. Step-down cyclo-converters

3. What is meant by step-up cyclo-converters?

In these converters, the output frequency is less than the supply frequency.

4. What is meant by step-down cyclo-converters?

In these converters, the output frequency is more than the supply frequency.

5. What are the applications of cyclo-converter?

- a. Induction heating
- b. Speed control of high power ac drives
- c. Power supply in aircraft or ship boards

6. What is meant by positive converter group in a cyclo converter?

The part of the cyclo-converter circuit that permits the flow of current during positive half cycle of output current is called positive converter group.

7. What is meant by negative converter group in a cyclo converter?

The part of the cyclo-converter circuit that permits the flow of current during negative half cycle of output current is called negative converter group.

1. A cycloconverter is a frequency converter from

1. higher to lower frequency with one-stage conversion
2. higher to lower frequency with two-stage conversion
3. lower to higher frequency with one-stage conversion
4. ac at one frequency to dc and then dc to ac at a different frequency

From these, the correct statements are

- (a) 2,4 (b) 1 only (c) 2,3 (d) 1,3

2. The cycloconverters (CCs) require natural or forced commutation as under:

- (a) natural commutation in both step-up and step-down CCs
- (b) forced commutation in both step-up and step-down CCs
- (c) forced commutation in step-up CCs
- (d) forced commutation in step-down CCs.

3. Consider the following statements regarding cycloconverters :

- 1. In 1-phase to 1-phase CC, firing angle may be varied
- 2. In 3-phase to 1-phase CC, firing angle may be kept constant
- 3. In 1-phase to 1-phase CC, firing angle may be kept constant
- 4. In 3-phase to 1-phase CC, firing angle may be varied
- 5. In 3-phase to 1-phase CC, firing angle must be varied.

From these, the correct statements are

- (a) 2,4, 5 (b) 1, 3,5 (c) 2,3, 5 (d) 2, 3 4

4. Which of the following statements are correct for cycloconverters?

- 1. Step-down cycloconverter (cc) works on natural commutation
- 2. Step-up cc requires forced commutation
- 3. Load commutated cc works on line commutation
- 4. Load commutated cc requires a generated emf in the load circuit.

From above! the correct statements are

- (a) 1,2 (b) 1,2, 4
- (c) 2, 3,4 (d) 1,2, 3

Answers: 1. (d) 2. (c) 3. (b) 4. (b)