Question Bank for Multiple Choice Questions

Program: Diploma in E&Tc Engineering	**Program Code:- EJ**
Scheme:-I	**Semester:- 4**
Course:-Basic power electronics	**Course Code:- 22427**

01 – Thyristor family devices	**Marks:-18**

Content of Chapter:-

1.1 SCR: Construction, operating principle with Two transistor analogy ,V-I characteristics ,latching current (IL) and holding current (IL) and holding current (Ih),applications of SCR

1.2 Thyristor family devices: LASCR SCS, GTO and TRIAC, Power MOSFET, IGBT: Construction, operating principle ,V-I Characteristics and applications.

1.3 Triggering devices-UJT,PUT,SUS,SBS and DIAC: Construction, operating principle, V-I characteristics and applications

1. Which of the following devices does not belong to the transistor family?
a) IGBT
b) MOSFET
c) GTO
d) BJT
Answer: c
Explanation: GTO is gate turn off transistor, it belongs to the Thyristor family. All the other devices belong to the transistor family.

2. A power transistor is a
a) three layer, three junction device
b) three layer, two junction device
c) two layer, one junction device
d) four layer, three junction device
Answer: b
Explanation: It has three layers p-n-p or n-p-n forming two p-n junctions.

3. In a power transistor, ____ is the controlled parameter.
a) V_{BE}
b) V_{CE}
c) I_B
d) I_C
Answer: d
Explanation: The collector current is the controlled parameter.

4. A power transistor is a _____ device.
a) two terminal, bipolar, voltage controlled
b) two terminal, unipolar, current controlled
c) three terminal, unipolar, voltage controlled
d) three terminal, bipolar, current controlled
Answer: d
Explanation: Power transistor is simply many BJT's connected in series parallel on a single silicon chip for power applications. It is a three terminal, bipolar, current controlled device.

5. In a power transistor, _____ is the controlling parameter.
a) V_{BE}
b) V_{CE}
c) I_B
d) I_C
Answer: c
Explanation: The base current controls the collector current. Hence, the base current Ib is the controlling parameter.

6. In a power transistor, the I_B vs V_{BE} curve is
a) a parabolic curve
b) an exponentially decaying curve
c) resembling the diode curve
d) a straight line Y = I_B
Answer: c
Explanation: The B-E junction of a BJT resembles a p-n junction diode, hence the curve.

7. For a power transistor, if the base current I_B is increased keeping V_{CE} constant, then
a) I_C increases
b) I_C decreases
c) I_C remains constant
d) none of the mentioned
Answer: a
Explanation: Ic is directly proportional to Ic.

8. The forward current gain α is given by
a) I_C/I_B
b) I_C/I_E
c) I_E/I_C
d) I_E/I_B
Answer: b
Explanation: Collector current by emitter current is the current gain, its value is close to one but never greater than.

9. The value of β is given by the expression
a) I_C/I_B
b) I_C/I_E
c) I_E/I_C
d) I_E/I_B
Answer: a
Explanation: Collector current by the base current is beta, its value is in the range 50 to 300.

10. A power BJT is used as a power control switch by biasing it in the cut off region (off state) or in the saturation region (on state). In the on state
a) both the base-emitter & base-collector junctions are forward biased
b) the base-emitter junction is reverse biased, and the base collector junction is forward biased
c) the base-emitter junction is forward biased, and the base collector junction is reversed biased
d) both the base-collector & the base-emitter junctions are reversed biased
Answer: a
Explanation: When base-emitter & base-collector junctions are forward biased only than both the p-n junctions are forward biased and the device is on.

11. The MOSFET combines the areas of _____ & _____
a) field effect & MOS technology
b) semiconductor & TTL
c) mos technology & CMOS technology
d) none of the mentioned
Answer: a
Explanation: It is an enhancement of the FET devices (field effect) using MOS technology.

12. Which of the following terminals does not belong to the MOSFET?
a) Drain
b) Gate
c) Base
d) Source
Answer: c
Explanation: MOSFET is a three terminal device D, G & S.

13. Choose the correct statement
a) MOSFET is a uncontrolled device
b) MOSFET is a voltage controlled device
c) MOSFET is a current controlled device
d) MOSFET is a temperature controlled device
Answer: b
Explanation: It is a voltage controlled device.

14. Choose the correct statement(s)
i) The gate circuit impedance of MOSFET is higher than that of a BJT
ii) The gate circuit impedance of MOSFET is lower than that of a BJT
iii) The MOSFET has higher switching losses than that of a BJT
iv) The MOSFET has lower switching losses than that of a BJT
a) Both i & ii
b) Both ii & iv
c) Both i & iv
d) Only ii
Answer: c
Explanation: MOSFET requires gate signals with lower amplitude as compared to BJTs & has lower switching losses.

15. Choose the correct statement
a) MOSFET is a unipolar, voltage controlled, two terminal device
b) MOSFET is a bipolar, current controlled, three terminal device
c) MOSFET is a unipolar, voltage controlled, three terminal device
d) MOSFET is a bipolar, current controlled, two terminal device
Answer: c
Explanation: MOSFET is a three terminal device, Gate, source & drain. It is voltage controlled unlike the BJT & only electron current flows.

16. The arrow on the symbol of MOSFET indicates
a) that it is a N-channel MOSFET
b) the direction of electrons
c) the direction of conventional current flow
d) that it is a P-channel MOSFET
Answer: b
Explanation: The arrow is to indicate the direction of electrons (opposite to the direction of conventional current flow).

17. The controlling parameter in MOSFET is
a) Vds
b) Ig
c) Vgs
d) Is
Answer: b
Exzlanation: The gate to source voltage is the controlling parameter in a MOSFET.

18. In the internal structure of a MOSFET, a parasitic BJT exists between the
a) source & gate terminals
b) source & drain terminals
c) drain & gate terminals
d) there is no parasitic BJT in MOSFET
Answer: b
Explanation: Examine the internal structure of a MOSFET, notice the n-p-n structure between the drain & source. A p-channel MOSFET will have a p-n-p structure.

19. In the transfer characteristics of a MOSFET, the threshold voltage is the measure of the
a) minimum voltage to induce a n-channel/p-channel for conduction
b) minimum voltage till which temperature is constant
c) minimum voltage to turn off the device
d) none of the above mentioned is true
Answer: a
Explanation: It is the minimum voltage to induce a n-channel/p-channel which will allow the device to conduct electrically through its length.

20.The output characteristics of a MOSFET, is a plot of
a) Id as a function of Vgs with Vds as a parameter
b) Id as a function of Vds with Vgs as a parameter
c) Ig as a function of Vgs with Vds as a parameter
d) Ig as a function of Vds with Vgs as a parameter
Answer: b
Explanation: It is Id vs Vds which are plotted for different values of Vgs (gate to source voltage).

21. Which among the following devices is the most suited for high frequency applications?
a) BJT
b) IGBT
c) MOSFET
d) SCR
Answer: c
Explanation: MOSFET has the least switching losses among the rest of the devices.

22. Choose the correct statement
a) MOSFET has a positive temperature co-efficient
b) MOSFET has a high gate circuit impedance
c) MOSFET is a voltage controlled device
d) All of the mentioned
Answer: d
Explanation: MOSFETs are voltage controlled devices. They have high gate circuit impedance and are PTC devices.

23. Consider an ideal MOSFET. If Vgs = 0V, then Id = ?
a) Zero
b) Maximum
c) Id(on)
d) Idd
Answer: a
Explanation: Gate current = 0 so device is off (ideally).

24. For a MOSFET Vgs=3V, Idss=5A, and Id=2A. Find the pinch of voltage Vp
a) 4.08
b) 8.16
c) 16.32
d) 0V
Answer: b
Explanation: Use Id = Idd x $[1-Vgs/Vp]^2$.

25. How does the MOSFET differ from the JFET?
a) JFET has a p-n junction
b) They are both the same
c) JFET is small in size
d) MOSFET has a base terminal
Answer: a

26. The basic advantage of the CMOS technology is that
a) It is easily available
b) It has small size
c) It has lower power consumption
d) It has better switching capabilities
Answer: c
Explanation: Complementary MOS consumes very less power as compared to all the earlier devices.

27. IGBT possess
a) low input impedance
b) high input impedance
c) high on-state resistance
d) second breakdown problems
Answer: b
Explanation: Like MOSFET IGBT possess high input impedance.

28. IGBT & BJT both posses ___
a) low on-state power losses
b) high on-state power losses
c) low switching losses
d) high input impedance
Answer: a
Explanation: Low on state power loss is one of the best parameters of both BJT & the IGBT.

29. The three terminals of the IGBT are
a) base, emitter & collector
b) gate, source & drain
c) gate, emitter & collector
d) base, source & drain
Answer: c
Explanation: IGBT is a three terminal device. It has a gate, a emitter & a collector.

30.In IGBT, the p^+ layer connected to the collector terminal is called as the
a) drift layer
b) injection layer
c) body layer
d) collector Layer
Answer: b
Explanation: It is called as a injection layer, because it injects holes into the n^- layer.

31. The controlling parameter in IGBT is the
a) I_G
b) V_{GE}
c) I_C
d) V_{CE}
Answer: b
Explanation: The controlling parameter is the gate to emitter voltage, as the device is a voltage controlled device.

32. In IGBT, the n^- layer above the p^+ layer is called as the
a) drift layer
b) injection layer
c) body layer
d) collector Layer
Answer: a
Explanation: It is called as the drift layer because its thickness determines the voltage blocking capabilities of the device.

33. The voltage blocking capability of the IGBT is determined by the
a) injection layer
b) body layer
c) metal used for the contacts
d) drift layer
Answer: d
Explanation: The drift layer which is a n^- layer determines the voltage blocking capabilities.

34. The controlled parameter in IGBT is the
a) I_G
b) V_{GE}
c) I_C
d) V_{CE}
Answer: c
Explanation: The controlling parameter is the gate to collector current.

35. The structure of the IGBT is a
a) P-N-P structure connected by a MOS gate
b) N-N-P-P structure connected by a MOS gate
c) P-N-P-N structure connected by a MOS gate
d) N-P-N-P structure connected by a MOS gate
Answer: c
Explanation: The IGBT is a semiconductor device with four alternating layers (P-N-P-N) that are controlled by a metal-oxide-semiconductor (MOS) gate structure without regenerative action.

36..The major drawback of the first generation IGBTs was that, they had
a) latch-up problems
b) noise & secondary breakdown problems
c) sluggish operation
d) latch-up & secondary breakdown problems
Answer: d
Explanation: The earlier IGBT's had latch-up problems (device cannot turn off even after the gate signal is removed), and secondary breakdown problems (in which a localized hotspot in the device goes into thermal runaway and burns the device out at high currents).

37.The GTO (gate turn-off thyristor) is a
a) p-n-p-n device
b) p-n-p device
c) p-metal-n device
d) p-n single junction device
Answer: a
Explanation: Just like a SCR, the GTO is a four layer p-n-p-n device.

38. The GTO can be turned off
a) by a positive gate pulse
b) by a negative gate pulse
c) by a negative anode-cathode voltage
d) by removing the gate pulse
Answer: b
Explanation: The GTO can be turned off by applying a negative gate pulse to the gate terminal.

39. The anode current is ideally limited by the
a) gate pulse amplitude
b) internal impedance of the device
c) load Impedance
d) gate circuit impedance
Answer: c
Explanation: The SCR or any device is connected through the load, hence the magnitude of the anode current (same as load current) will depend on the supply voltage and load impedance.

40. In a GTO the n^+ layer forms the
a) anode & gate
b) cathode & gate
c) cathode
d) gate
Answer: c
Explanation: The bottom n^+ layer forms the cathode.

41. The turn-off gain β_{off} of the GTO is given by
a) I_g/I_a
b) I_a/I_g
c) V_g/V_a
d) V_g/V_a
Answer: b
Explanation: β_{off} = (anode current/gate current).

42. 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
Answer: c
Explanation: An SCR (silicon controlled rectifier) is a four layer p-n-p-n type device.

43.. Which terminal does not belong to the SCR?
a) Anode
b) Gate
c) Base
d) Cathode
Answer: c
Explanation: The SCR is having three terminals viz. anode, cathode and the gate.

44. An SCR is a
a) four layer, four junction device
b) four layer, three junction device
c) four layer, two junction device
d) three layer, single junction device
Answer: b
Explanation: SCR is a four layer p-n-p-n device which forms three p-n junctions.

45. Choose the false statement.
a) SCR is a bidirectional device
b) SCR is a controlled device
c) In SCR the gate is the controlling terminal
d) SCR are used for high-power applications
Answer: a
Explanation: It is a unidirectional device, current only flows from anode to cathode.

46. In the SCR structure the gate terminal is located
a) near the anode terminal
b) near the cathode terminal
c) in between the anode & cathode terminal
d) none of the mentioned
Answer: b
Explanation: The gate is located near the cathode, because it allows fast turning on of the device when the gate signal is applied by forward basing the second junction.

47. The static V-I curve for the SCR is plotted for
a) Ia (anode current) vs Ig (gate current), Va (anode – cathode voltage) as a parameter
b) Ia vs Va with Ig as a parameter
c) Va vs Ig with Ia as a parameter
d) Ig vs Vg with Ia as a parameter
Answer: b
Explanation: The curve is plotted for Ia vs Va for different values of gate current Ig.

48.. If the cathode of an SCR is made positive with respect to the anode & no gate current is applied then
a) all the junctions are reversed biased
b) all the junctions are forward biased
c) only the middle junction is forward biased
d) only the middle junction is reversed biased
Answer: c
Explanation: The device is in the reverse blocking state (3rd quadrant) & only the middle junction is forward biased whereas other two are reversed biased.

49. 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
Answer: c
Explanation: In the reverse blocking mode, the gate current is zero & a reverse voltage is applied at the cathode-anode.

50. With the anode positive with respect to the cathode & the gate circuit open, the SCR is said to be in the
a) reverse blocking mode
b) reverse conduction mode
c) forward blocking mode
d) forward conduction mode
Answer: c
Explanation: The SCR is in the forward blocking mode with its top and bottom junctions forward biased and the middle junction reversed biased.

51. For an SCR in the forward 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
Answer: b
Explanation: In the forward blocking mode, the gate current is zero & only the middle J2 junction is reversed biased.

52. How many layers of semiconductor does a TRIAC (Triode alternating current) have?
a) 1
b) 2
c) 3
d) 4
Answer: d
Explanation: A TRIAC (Triode alternating current) is a 4 layered semiconductor device. It has three terminals and it is bidirectional. It is widely used in power electronics for control purpose.

53. What is the full form of SCR?
a) Silicon controlled rectifier
b) Silicate controlled rectifier
c) Silicon controlled rectification
d) Silicon controlling rectification
Answer: a
Explanation: SCR stands for Silicon controlled rectifier. It is a unidirectional device and has 4 layers of semiconductors fused together. The current through it flows in one direction only.

54. How many minimum thyristors make up a TRIAC (Triode alternating current)?
a) 0
b) 1
c) 2
d) 3
Answer: c
Explanation: 2 thyristors make up a TRIAC (Triode alternating current). These thyristors are connected parallel to each other but in opposite direction. Their gates are made common, which makes it a 3 terminal device.

55.. How many terminals does a TRIAC (Triode alternating current) have?
a) 1
b) 2
c) 3
d) 4
Answer: c
Explanation: TRIAC (Triode alternating current) is a 3 terminal device. It has got two thyristors are connected parallel to each other but in opposite direction which forms a TRIAC (Triode alternating current). The third terminal is the common gate o these thyristors.

56. How many doped regions do a standard TRIAC have?
a) 1
b) 6
c) 3
d) 4
Answer: b
Explanation: A standard TRIAC has 6 doped regions. The gate terminal makes ohmic contact between p-type and N-type materials. The other two terminals are similar therefore there is no specific anode and cathode terminal.

57.How many minimum thyristors are required to make a TRIAC (Triode alternating current)?
a) 0
b) 1
c) 2
d) 3
Answer: c
Explanation: 2 thyristors are required to make a TRIAC (Triode alternating current). These thyristors are connected parallel to each other but in opposite direction. Their gates are made common, which makes it a 3 terminal device.

58. How many terminals does a DIAC (Diode alternating current) have?
a) 1
b) 2
c) 3
d) 4
Answer: b
Explanation: DIAC (Diode alternating current) is a 2 terminal device. It has got two zener diodes connected back to back which forms a DIAC (Diode alternating current). The two terminals are anode terminals in a PNPN DIAC (Diode alternating current).

59. What are present at the potential barrier of a PN junction when no external voltage is applied?
a) Electrons
b) Holes
c) Positive Ions
d) Positive and Negative Ions
Answer: d
Explanation: Positive and Negative Ions are present at the potential barrier of a PN junction when no external voltage is applied. These Ions are immobile and are accumulated which does not allow the electrons and holes to cross the junction until an external voltage is applied.

60. How many layers of semiconductor does a DIAC have?
a) 1
b) 2
c) 3
d) 4
Answer: d
Explanation: A DIAC (Diode alternating current)is a 4 layered semiconductor device. It has alternating P-type and N-type semiconductor fused together. Together these 4 layers form up a DIAC (Diode alternating current).

61. What is the full form of DIAC?
a) Diode for alternating current
b) Diode attenuating current
c) Dioxide for analogous current
d) Diode analogous current
Answer: a
Explanation: DIAC stands for Diode for alternating current. It only conducts current when the applied voltage crosses breakdown voltage. DIAC is a 2 terminal device. It has got two zener diodes connected back to back which forms a DIAC.

62.. What is the full form of TRIAC?
a) Triode attenuating current
b) Triode for alternating current
c) Trioxide for analogous current
d) Triode analogous current
Answer: b
Explanation: TRIAC stands for Triode for alternating current. 2 thyristors are required to make a TRIAC. It is a three terminal device. The thyristors are connected parallel to each other but in opposite direction and their gates are made common.

63. How many layers and junctions does an SCR have?
a) Four layers and three junctions
b) Three layers and four junctions
c) Three layers and three junctions
d) Four layers and four junctions
Answer: a
Explanation: An SCR has four layers and three junctions. The layers are the p-n-p-n layer and there are three p-n junctions. There are three terminals named as anode, cathode and the gate terminal. The other options mentioned above are incorrect.

64.. An SCR is a ____
a) semiconductor device
b) full conductor device
c) inductor device
d) bidirectional device
Answer: a
Explanation: SCR is a Semiconductor device. It is made up of silicon. As the conduction takes place only in a single direction, an SCR is a unidirectional device. The other options are incorrect.

65. Which among the following are not the parts of SCR?
a) Anode
b) Cathode
c) Gate
d) Base
Answer: d
Explanation: An SCR has three terminals anode, cathode and gate. It does not consist of a base. It has four layers and three junctions. As the conduction takes place only in a single direction, an SCR is a unidirectional device.

66. A silicon controlled rectifier (SCR) is a
a) Unijunction device
b) Dvice with three junction
c) Device with four junction
d) None of the above
Answer.2. Device with three junction

Explanation:-Silicon controlled rectifier or semiconductor-controlled rectifier is a four-layer solid-state current-controlling unidirectional devices (i.e. can conduct current only in one direction).

67. A thyristor is basically

a) PNPN device

b) A combination of diac and triac

c) A set of SCRs

d) A set of SCR, diac and a triac

Answer.a). PNPN device

Explanation:-The thyristor is also called a silicon-controlled rectifier (*SCR), is basically* a four-layer three-junction pnpn device. It has three terminals: anode, cathode, and gate. It is basically an electronic switching device which can remain in conducting (on) and nonconducting (OPI:) state. However, it is a unidirectional device and can conduct only in one direction like a diode. The switching state of the device can be controlled by one of its terminals.

74. Which semiconductor power device out of the following, is not a current triggering device?

1. Thyristor
2. Triac
3. G.T.O
4. MOSFET

Answer.4. MOSFET

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02 – Turn ON and OFF methods of SCR	Marks:-14

Content of Chapter:-

2.1 concepts of turn ON mechanism of SCR: High voltage thermal triggering,illumination triggering,dv/dt triggering,gate triggering of SCR.

2.2 Gate trigger circuits: resistance triggering circuits, resistance triggering circuit

2.3 SCR triggering method : UJT/PUT –relaxation oscillator circuits,synchronized UJT triggering circuit,pulse transformer and optocoupler (MCT2E)

2.4 Turn off methods : Class A- series resonant commutation circuit,class-B shunt resonant commutation circuit,Class C- complimentary symmetry commutation circuits

2.5 Protection circuits of SCR :over voltage ,over current ,snubbercircuits and crowbar.

1. The thyristor turn-off requires that the anode current
a) falls below the holding current
b) falls below the latching current
c) rises above the holding current
d) rises above the latching current
Answer: a
Explanation: For effective turn-off of the SCR the anode current must fall below the holding current value.

2. In case of class A type commutation or load commutation with low value of R load the
a) L is connected across R
b) L-C is connected across R
c) L is connected in series with R
d) L-C is connected in series with R
Answer: d
Explanation: In case of Class A commutation the requirement is that the circuit should be an under-damped RLC circuit.

3. The class A commutation or load commutation is possible in case of
a) dc circuits only
b) ac circuits only
c) both DC and AC circuits
d) none of the above mentioned
Answer: a
Explanation: The nature of the circuit should be such that when energized from the source, current must a a natural tendency to decay to zero for load commutation to occur in a SCR circuit.

4. In case of class B commutation or resonant-pulse commutation with L = 5 μH and C = 20 μC with initial voltage across the capacitor (Vs) = 230 V. Find the peak value of resonant current.
a) 560 A
b) 460 A
c) 360 A
d) 260 A
Answer: b
Explanation: Ip = Vs x √C/L.

5. In case of class B commutation or resonant-pulse commutation with L = 5 μH and C = 20 μC with the initial voltage across the capacitor (Vs) = 230 V. Find the conduction time for auxiliary thyristor.
a) 0.23 μs
b) 6.57 μ
c) 31.41 μs
d) 56 μs
Answer: c
Explanation: Ip = Vs x √C/L
ω = 1/√LC
t = π/ω.

6. An SCR is connected in series with L = 5 mH and C = 20 μF. Find the resonant frequency of the circuit.
a) 2569 rad/s
b) 3162 rad/s
c) 2400 rad/s
d) 7889 rad/s
Answer: b
Explanation: ω = 1/√LC.

7. The type of commutation when the load is commutated by transferring its load current to another incoming thyristor is
a) class A or load commutation
b) class B or resonant commutation
c) class C or complementary commutation
d) class D or impulse commutation
Answer: c
Explanation: In the Class C type commutation also called as complementary commutation the load is commutated by transferring the current th another device.

8. The type of commutation in which the pulse to turn off the SCR is obtained by separate voltage source is
a) class B commutation
b) class C commutation
c) class D commutation
d) class E commutation
Answer: d
Explanation: In class E commutation, another voltage source is used. It is also called as external pulse commutation.
9. The natural reversal of ac supply voltage commutates the SCR in case of
a) forced commutation
b) only line commutation
c) only natural commutation
d) both line & natural commutation
Answer: d
Explanation: Both line and natural commuataion are used in converters.

10. _____ commutation technique is commonly employed in series inverters.
a) line
b) load
c) forced
d) external-pulse
Answer: b
Explanation: Load commuation is used in inverter in which L and C are connected in series with the load or C in parallel with the load such that overall load circuit is under damped.

11. Natural commutation of an SCR takes place when
a) voltage across the device becomes negative
b) voltage across the device becomes positive
c) gate current becomes zero
d) anode current becomes zero
Answer: d
Explanation: Anode current (load current) becomes zero and turns off the device, hence the name line commutation.

12. _____ commutation is usually used in phase-controlled rectifiers
a) line
b) load
c) forced
d) external-pulse
Answer: a
Explanation: Line commuataion is used in converters.

13. Parallel-capacitor commutation is
a) line commutation
b) load commutation
c) forced commutation
d) external-pulse commutation
Answer: c
Explanation: Parallel capacitor is another name for forced commutation.

14. Class E commutation is a/an
a) line commutation technique
b) load commutation technique
c) forced commutation technique
d) external-pulse commutation technique
Answer: d
Explanation: As an external source is used it is a external-pulse commutation technique.

15.During the transition time or turn-on time
a) The forward anode voltage decreases from 90 % to 10 % & the anode current also decreases from 90 to 10 % of the initial value
b) The forward anode voltage increases from 10 % to 90 % & the anode current also increases from 10 % to 90 % of the initial value
c) The forward anode voltage decreases from 90 % to 10 % & the anode current increases from 10 % to 90 % of the initial value
d) The forward anode voltage increases from 10 % to 90 % & the anode current decreases from 90% to 10% of the initial value
Answer: c
Explanation: During the turn on time, the voltage across the SCR is going down and the current through it is slowly rising as it is going into the conduction mode.

16. For an SCR the total turn-on time consists of
i) Delay time
ii) Rise time and
iii) Spread time
During the delay time the
a) anode current flows only near the gate
b) anode current rises from zero to very high value
c) losses are maximum
d) anode to cathode voltage is zero
Answer: a
Explanation: Initially for a fraction of a microsecond (delay time) after the gate signal is applied the anode current only flows near the gate terminal where the gate current density is maximum, as the gate current takes some time to spread all over the cross section of the device.

17. 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
Answer: a
Explanation: The device will remain in the conducting state unless the anode current falls below the holding current value.

18. For an SCR the total turn-on time consists of
i) Delay time
ii) Rise time and
iii) Spread time
During the rise time the
a) anode current flows only near the gate
b) anode current rises from zero to very high value
c) losses are maximum
d) anode to cathode voltage is zero
Answer: c
Explanation: The losses are maximum during the rise time because both Ia & Va are high.

19. The latching current is _____ than the holding current
a) lower
b) higher
c) same as
d) negative of
Answer: b
Explanation: The latching current is the value of current on which the device will remain in the on state even after removal of the gate signal. Whereas, the holding current is the threshold above which the device will work.

20. For an SCR the total turn-on time consists of
i) Delay time
ii) Rise time and the
iii) Spread time
The spread time interval depends upon
a) the value of gate current
b) junction temperature
c) area of the cathode
d) area of the anode
Answer: c
Explanation: During the spread time the conduction starts spreading all over the SCR cathode cross-section structure, which depends upon the structure of the gate & cathode. Higher the cathode area more is the time required for the charges to spread all over.

21. For effective turning off of the SCR after the anode current has reached zero value, _____
a) chargers are injected by applying reverse anode-cathode voltage
b) chargers are removed by applying reverse anode-cathode voltage
c) chargers are injected by applying gate signal
d) chargers are removed by applying gate signal
Answer: b
Explanation: To enable the device to regain its reverse blocking capabilities, the stored charges in the junctions of the SCR must be removed.

22. To avoid commutation failure
a) circuit turn-off time must be greater than the thyristor turn-off time
b) circuit turn-off time must be lesser than the thyristor turn-off time
c) circuit turn-off time must be equal to the thyristor turn-off time
d) none of the above mentioned
Answer: a
Explanation: If the thyristor turn off time is more than the circuit turn off time, the circuit will be turned off and the thyristor will keep conducting, which is not at all desirable.

23. The gate characteristics of thyristor is a plot of
a) V_g on the X-axis & I_g on the Y-axis
b) I_g on the X-axis & V_g on the Y-axis
c) V_a on the X-axis & I_g on the Y-axis
d) I_g on the X-axis & V_a on the Y-axis
Answer: b
Explanation: It is the gate current versus the gate voltage plot and gives the minimum and maximum values of gate parameters.

24. The area under the curve of the gate characteristics of thyristor gives the
a) total average gate current
b) total average gate voltage
c) total average gate impedance
d) total average gate power dissipation
Answer: d
Explanation: As the gate characteristics is a plot of Ig vs Vg consisting of two curves one for the maximum values & other for the minimum the area between them gives the total average gate power dissipation. (A very important parameter in designing of the triggering circuits).

25. If the RC firing circuit used for firing an SCR is to be used to fire a TRIAC then
a) the capacitor should be removed
b) the diode should be replaced by a diac
c) the diode should be replaced by a bjt
d) the diode should be shorted using a resistor
Answer: b
Explanation: The TRIAC is a bidirectional SCR, hence it will need gating in both the directions. This can be achieved by replacing the diode by a DIAC (bidirectional diode).

26. In the thyristor gating circuit, the supply to the pulse amplifier is provided by the
a) zcd
b) isolation transformer
c) synchronizing transformer
d) control signal generator
Answer: b
Explanation: Isolation transformer provides the supply to the amplifier and also provides the necessary isolation for the load and triggering circuit.

27. In the thyristor gating circuit, the ZCD is used to
a) amplify the voltage
b) produce a train of pulses
c) convert AC input the ramp voltage
d) used to step-down the voltage
Answer: c
Explanation: It is used to convert the AC synchronizing input voltage into ramp voltage & synchronizes it with the zero crossing of the AC supply.

28. The firing-angle delay is
a) inversely proportional to the synchronizing transformer voltage
b) inversely proportional to the control signal voltage
c) directly proportional to the synchronizing transformer voltage
d) directly proportional to the control signal voltage
Answer: d
Explanation: If Ec is lowered the firing angle decreases & vice-verse.

29.The pulse gating is not suitable of
a) R loads
b) RC loads
c) RL loads
d) It is suitable of every type of load
Answer: c
Explanation: It is not suitable of RL load because initiation of SCR conduction is not well defined in these types of loads.

30. In case of a cosine firing scheme, _____ is used to get a cosine wave
a) ic 555
b) a comparator
c) an integrator circuit
d) a differentiator circuit
Answer: c
Explanation: The Sync.Transformer is connected to a integrator to obtain a cosine-wave.

31. If the gating circuits generator negative pulses, then those can be removed by using
a) schmit triggers
b) clippers
c) clampers
d) zener diodes
Answer: b
Explanation: The clippers can be used to clip the negative part.

32. The improved version of the UJT oscillator triggering circuit is the
a) ramp & pedal triggering
b) rc triggering
c) cosine-pulse triggering
d) ramp triggering
Answer: a
Explanation: The ramp & pedal triggering is the improved version of the UJT oscillator triggering circuit.

33.. R_{B1} = 3 kΩ & R_{B2} = 6 kΩ. Find the intrinsic stand-off ratio (η) of the UJT.
a) 9
b) 1/3
c) 2/3
d) 3
Answer: b
Explanation:
$\eta = R_{B1}/(R_{B1}+R_{B1})$.

33.. The decaying factor in the wave shape of the output pulses from the pulse transformer is its
a) transformer ratio
b) inductance
c) capacitance
d) resistance
Answer: b
Explanation: L is the decaying factor in the waveform which emerges from the PT.

34.. _____ device from the thyristor family has its gate terminal connected to the n-type material near the anode.
a) SCR
b) RCT
c) PUT
d) SUT
Answer: c
Explanation: PUT is Programmable Unijunction Transistor which is a p-n-p-n device just like the SCR with its gate connected to the n-type material.

35. The Programmable Unijunction Transistor (PUT) turns on & starts conducting when the
a) gate voltage exceeds anode voltage by a certain value
b) anode voltage exceeds gate voltage by a certain value
c) gate voltage equals the anode voltage
d) gate is given negative pulse w.r.t to cathode
Answer: b
Explanation: The device only starts to conduct when the forward anode to cathode voltage exceeds the applied gate to cathode voltage.

36. The equivalent circuit of SUS (Silicon Unilateral Switch) consists of
a) a diode in series with a PUT
b) a diode in parallel with a PUT
c) a diode in anti-parallel with a PUT
d) two diodes
Answer: c
Explanation: It is a diode connected in anti-parallel with a PUT.

37. From the following list of devices, choose the device that only turns-on for a fixed-value of anode-cathode voltage
a) PUT
b) SCR
c) SUS
d) BJT
Answer: c
Explanation: Unlike the other devices the SUS only turns-on for a fixed value of anode to cathode voltage.

38. The SCS (Silicon Controlled Switch) is a
a) two terminal device
b) three terminal device
c) four terminal device
d) five terminal device
Answer: c
Explanation: The SCS is a four terminal device A,K,KG & AG.

39. The SCS is a four layer, four terminal thyristor. Can be turned on by
a) the anode gate
b) the cathode gate
c) either of the gates
d) gating both the gates together
Answer: c
Explanation: The SCS has two gates, anode-gate and cathode-gate. Either of the gates could be used to turn on the device.

40. The SCS (Silicon Controlled Switch) can be turned on by two methods, by applying _____ and _____
a) positive pulse to the anode gate, positive pulse to the cathode gate
b) positive pulse to the anode gate, negative pulse to the cathode gate
c) negative pulse to the anode gate, positive pulse to the cathode gate
d) negative pulse to the anode gate, negative pulse to the cathode gate
Answer: c
Explanation: Either of the gates could be used to turn on the device.

41. Which of the following devices provide complete isolation between triggering circuit and power circuit?
a) PUT
b) LASCR
c) SUS
d) DIAC
Answer: b
Explanation: Complete Isolation between triggering circuit & power circuit is the major advantage of using LASCR as they are light activated or light trigged.

42 The DIAC can be represented by
a) two SCRs in anti-parallel
b) two SCRs in parallel
c) two diodes in anti-parallel
d) two diodes in parallel
Answer: c
Explanation: The DIAC is nothing but a bi-directional diode.

43. The TRIAC can be represented by
a) two SCRs in anti-parallel
b) two SCRs in parallel
c) two diodes in anti-parallel
d) two diodes in parallel
Answer: a
Explanation: The TRIAC is a bidirectional SCR.

44. The thyristor turn-off requires that the anode current
a) falls below the holding current
b) falls below the latching current
c) rises above the holding current
d) rises above the latching current
Answer: a
Explanation: For effective turn-off of the SCR the anode current must fall below the holding current value.

45. di/dt protection is provided to the thryistor by
a) connecting an inductor in parallel across the load
b) connecting an inductor in series with the load
c) connecting an inductor in parallel across the gate terminal
d) connecting an inductor in series with the gate
Answer: b
Explanation: By placing the di/dt inductor (L) in series with the load, the change in the anode current can be limited to a small value.

46. The local hot spot formation in the cross-section of the SCR is avoided by
a) reducing the junction temperature
b) applying gate current nearer to the maximum gate current
c) using only R loads
d) proper mounting of the SCR on heat sink
Answer: b
Explanation: Applying the higher gate current spreads the ions quickly and avoids hotspot formation.

47. The dv/dt protection is provided in order to
a) limit the power loss
b) reduce the junction temperature
c) avoid accidental turn-on of the device
d) avoiding sudden large voltage across the load
Answer: c
Explanation: Accidentally some voltage spike or noise may occur in the vicinity of the device, if the magnitude is large enough it may turn on the SCR.

48. The effect of over-voltages on SCR are minimized by using
a) RL circuits
b) Circuit breakers
c) Varistors
d) di/dt inductor
Answer: c
Explanation: Varistors are non-linear voltage clamping devices, RC circuits across the loads can also be used.

49. Over-current protection in SCRs is achieved through the use of
a) Varistors
b) Snubber Circuits
c) F.A.C.L.F & C.B.
d) Zener diodes
Answer: c
Explanation: FACLF stands for Fast Acting Current Limiting Fuse.

50. The thyristor turn-off requires that the anode current
a) falls below the holding current
b) falls below the latching current
c) rises above the holding current
d) rises above the latching current
Answer: a
Explanation: For effective turn-off of the SCR the anode current must fall below the holding current value.

50. In case of class A type commutation or load commutation with low value of R load the
a) L is connected across R
b) L-C is connected across R
c) L is connected in series with R
d) L-C is connected in series with R
Answer: d
Explanation: In case of Class A commutation the requirement is that the circuit should be an under-damped RLC circuit.

51. The class A commutation or load commutation is possible in case of
a) dc circuits only
b) ac circuits only
c) both DC and AC circuits
d) none of the above mentioned
Answer: a
Explanation: The nature of the circuit should be such that when energized from the source, current must a a natural tendency to decay to zero for load commutation to occur in a SCR circuit.

52. The type of commutation when the load is commutated by transferring its load current to another incoming thyristor is
a) class A or load commutation
b) class B or resonant commutation
c) class C or complementary commutation
d) class D or impulse commutation
Answer: c
Explanation: In the Class C type commutation also called as complementary commutation the load is commutated by transferring the current th another device.

53. The type of commutation in which the pulse to turn off the SCR is obtained by separate voltage source is
a) class B commutation
b) class C commutation
c) class D commutation
d) class E commutation
Answer: d
Explanation: In class E commutation, another voltage source is used. It is also called as external pulse commutation.

03 – Phase controlled Rectifers	Marks:-14

Content of Chapter:-

3.1 phase control parameters: firing angle (alpha) and conducation angle(phase)

3.2 Single phase half wave controlled rectifier: circuit diagram,working and waveform with R and RL load effect of freewheeling diode with RL load

3.3 Single phase centre tapped full wave controlled rectifier:circuit diagram ,working and waveform with RL load

Effect of freewheeling diode with RL load

3.4 Basic three phase half wave controlled rectifiers.

1. Find the expression for the average value of the output voltage for the below given circuit. Consider the load current to be continuous, firing angle = α, transformer ration 1:1 and Vs = Vm sinωt.

a) (Vm/π)cosα

b) (Vm/π)(1+cosα)

c) (2Vm/π)cosα

d) (2Vm/π)(1+cosα)

Answer: c

Explanation: As the load current is continues, the voltage is positive from α to π and negative from π to π+α and so on. Thus,

Vavg = 1/Period ∫ Vm sin⁡ωt d(ωt)

Where period = π

And the integral runs from α to α+π.

2. A fully controlled converter uses

a) diodes only

b) thyristors only

c) both diodes and thyristors

d) none of the mentioned

Answer: b

Explanation: Fully controlled implys that all the elements are "fully controlled" hence, it uses SCRs only except the FD.

3. A single phase full-converter using R load is a _____ quadrant converter and that using an RL load without FD is a _____ quadrant converter

a) one, one

b) two, one

c) one, two

d) two, two

Answer: c

Explanation: In R load both V and I are positive, in RL load the voltage can be negative but current is always positive.

4. A single phase full controlled bridge converter (B-2) uses
a) 4 SCRs and 2 diodes
b) 4 SCRs
c) 6 SCRs
d) 4 SCRs and 2 diodes
Answer: b
Explanation: 4 SCR's are connected in a bridge fashion.

5. In a B-2 type full controlled bridge converter
a) one SCR conducts at a time
b) two SCRs conduct at a time
c) three SCRs conduct at a time
d) four SCRs conduct at a time
Answer: b
Explanation: B-2 is the bridge type controller, in which 2 devices conduct at a time. One acting as the current supplying path and other acts as a return path.

6. 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
Answer: a
Explanation: The FD feeds inductor current again to the load.

7. A 230 V, 50 Hz, one-pulse SCR controlled converter has extinction angle $\beta = 210°$. Find the circuit turn-off time
a) 10 m-sec
b) 0
c) 8.3 m-sec
d) 5.4 m-sec
Answer: c
Explanation: $t = 2\pi-\beta/\omega$
Where, $\pi = 90°$
$\omega = 2x\pi x50$
$\beta = 210°$.

8. A 230V, 50Hz, single-pulse SCR is feeding a RL load with α = 40° and β = 210°. Find the value of average output voltage
a) 54 V
b) 106 V
c) 84 V
d) 32 V
Answer: c
Explanation:
Vo = Vm/2π x (cosα-cosβ)
Where Vm = √2Vs.

9. A single-pulse transformer with secondary voltage of 230 V, 50 Hz, delivers power to bulb of R = 10 Ω through a half-wave controlled rectifier circuit. For α = 60°, find the average current in the bulb
a) 2.5 A
b) 7.7 A
c) 9.6 A
d) 3 A
Answer: b
Explanation: First find the average voltage, than Io = Vo/R
Vo = (Vm/2π) x (1+cosα).

8. A single-pulse transformer with secondary voltage of 230 V, 50 Hz, delivers power to bulb of R = 10 Ω through a half-wave controlled rectifier circuit. For α = 60° and output AC power of 2127 Watts, find the rectification efficiency
a) 98.6 %
b) 42 %
c) 28 %
d) 19 %
Answer: c
Explanation:
Vo = (Vm/2π) x (1+cosα) = 77.64 V
Pdc = Vo^2xR = 602.8 W
Rectification efficiency = Pdc/Pac = 28.32 %.

9. A single-phase two pulse converter feeds RL load with a sufficient smoothing such that the load current does not fall to zero. If the resistance of the load circuit is increased then the
a) ripple content is not affected
b) ripple content of current increases
c) ripple content of current decreases
d) load current may fall to zero
Answer: b
Explanation: If the resistance of the load circuit is increased then the ripple content of current increases.

10. In case of controlled rectifiers, the nature of the load current (continues or discontinuous) depends upon the
a) type of load and firing angle
b) only on the type of load
c) only on the firing angle
d) it is independent of all the parameters
Answer: a
Explanation: It depends on both as firing angle will decide how fast and how much current flows. The load R, Rl or RLE can also effect the current depending upon the values of L and E.

11. In a three-phase half wave rectifier usually, the primary side of the transformer is delta connected because
a) it has no neutral connection
b) we can get greater output voltage
c) it provides a path for the triplen harmonics
d) it provides better temperature stability
Answer: c
Explanation: The delta connected winding help circulating and eliminating the triplen (3rd order) harmonics.

12. In a three-phase half wave diode rectifier using 3 diodes, each diode conducts for
a) 90 degrees
b) 120 degrees
c) 180 degrees
d) 360 degrees
Answer: b
Explanation: Each diode conducts for 120 degrees, starting from ωt = 30 degrees.

13. In a three-phase half wave diode rectifier using 3 diodes,
a) All diodes conduct together
b) Only two diodes conduct at a time
c) Only one diode conducts at a time
d) None of the above mentioned
Answer: c
Explanation: 3 diodes, each conduct for 120 degree at a time.

14. In a three-phase half wave diode rectifier, if Vmp is the maximum phase voltage, then the output voltage on a R load varies from
a) 0 to Vmp
b) 0.5 Vmp to Vmp
c) Vmp to 3Vmp
d) –Vmp to Vmp
Answer: b
Explanation: The voltage value is positive and varies from (1/2)Vmp to Vmp.

15. The average value of the output voltage, in a 3-phase half wave diode rectifier with Vml as the maximum line voltage value, is given by the expression
a) Vml/3π
b) 2Vml/3π
c) 3Vml/2π
d) 3Vml
Answer: c
Explanation: The average value can be obtained by
3 x [1/2π x Vml sin ωt d(ωt)]
The integration runs from π/6 to 5π/6 as the diode is conducting for 120 degrees each.

16. In a three-phase half wave 6-pulse mid-point type diode rectifier, each diode conducts for
a) 120°
b) 60°
c) 90°
d) 180°
Answer: b
Explanation: In a six-pulse rectifier, each diode conducts once every one cycle, 60° x
6 diodes = 360°.

17. For a single phase, full bridge, diode rectifier excited from a 230 V, 50 Hz source. With R = 10 Ω & the inductance(L) large enough to maintain continuous conduction, the value of the supply power factor will be
a) 0.707 lag
b) 0.9 lag
c) 0.86 lag
d) Unity
Answer: b
Explanation:
Pf = Vs.Is.cosθ/Vo.Io
Io = Vo/R A
Vo = 2Vm/π Volts.

18. The rectification efficiency for B-2 type & M-2 type full wave diode rectifiers are ___ & ___ respectively.
a) 8/π & 4/π
b) 4/π & 8/π
c) 8/π & 8/π
d) 4/π & 4/π
Answer: c
Explanation: B-2 type has efficiency 8/π. M-2 type has efficiency half of that of a B-2 type.

19. A load of R = 60 Ω is fed from 1phase, 230 V, 50 Hz supply through a step-up transformer & than a diode. The transformer turns ratio = 2. The power delivered to the load is
a) 614 Watts
b) 714 Watts
c) 814 Watts
d) 914 Watts
Answer: b
Explanation: $P = Vo^2/R$
$Vo = Vm/\pi$
AC supplied to the rectifier is 2 x 230 = 460 V (rms)
Therefore, $Vo = \sqrt{2} \times 460 / \pi = 207.04$
P = 714.43 W.

20. The average value of the output voltage, in a 3-phase half wave diode rectifier with Vml as the maximum line voltage value, is given by the expression
a) Vml/3π
b) 2Vml/3π
c) 3Vml/2π
d) 3Vml
Answer: c
Explanation: The average value can be obtained by
$3 \times [1/2\pi \times Vml \sin \omega t \, d(\omega t)]$
The integration runs from π/6 to 5π/6 as the diode is conducting for 120 degrees each.

21. In a three-phase half wave 6-pulse mid-point type diode rectifier, each diode conducts for
a) 120°
b) 60°
c) 90°
d) 180°
Answer: b
Explanation: In a six-pulse rectifier, each diode conducts once every one cycle, 60° x 6 diodes = 360°.

22. In a three-phase half wave rectifier usually, the primary side of the transformer is delta connected because
a) it has no neutral connection
b) we can get greater output voltage
c) it provides a path for the triplen harmonics
d) it provides better temperature stability
Answer: c
Explanation: The delta connected winding help circulating and eliminating the triplen (3rd order) harmonics.

23. For α > 90°, 3-Φ Full wave bridge rectifier acts as a natural commutated inverter.
a) True
b) False
c)0
d)5
Answer: a
Explanation: The output voltage of 3-Φ Full wave bridge rectifier is $3V_{ml}(\cos(\propto))\div\pi$. For α > 90° the output voltage becomes negative. The power flows from DC to the AC side.

24. What is the formula for output voltage for 3-Φ Full wave bridge rectifier for R-L load?
a) $3V_{ml}(\cos(\propto))\div2\pi$
b) $3V_{ml}(\cos(\propto))\div\pi$
c) $2V_{ml}(\cos(\propto))\div\pi$
d) $6V_{ml}(\cos(\propto))\div\pi$
Answer: b
Explanation: The output voltage of 3-Φ Full wave bridge rectifier for R-L load is $3V_{ml}(\cos(\propto))\div\pi$. The net area of the output voltage for R-L load remains zero.

25. The output voltage of 3-Φ Full wave bridge rectifier is six times of 3-Φ Half-wave rectifier.
a) True
b) False
Answer: b
Explanation: The output voltage of 3-Φ Full wave bridge rectifier is $3V_{ml}(\cos(\propto))\div\pi$. The output voltage of 3-Φ Half wave rectifier is $3V_{ml}(\cos(\propto))\div2\pi$.

26. What is the formula for output voltage for 3-Φ Full wave bridge rectifier for R load for α < 60°?
a) $2V_{ml}(\cos(\propto))\div\pi$
b) $3V_{ml}(\cos(\propto))\div2\pi$
c) $3V_{ml}(\cos(\propto))\div\pi$
d) $6V_{ml}(\cos(\propto))\div\pi$
Answer: c
Explanation: The output voltage of 3-Φ Full wave bridge rectifier for R load is $3V_{ml}(\cos(\propto))\div\pi$ for α < 60°. Conduction will only remain from 60°+α to 120°+α.

27.. _____ is the boundary for C.C.M and D.C.M mode in 3-Φ Full wave bridge rectifier for R load.
a) 60°
b) 10°
c) 80°
d) 50°
Answer: a
Explanation: 60° is the boundary for C.C.M and D.C.M mode in 3-Φ Full wave bridge rectifier for R load. Conduction will only remain from 60°+α to 120°+α.

28. What is the formula for output voltage for 3-Φ Full wave bridge rectifier for R load for α > 60°?
a) $2V_{ml}(1+\cos(\propto+60°))\div\pi$
b) $3V_{ml}(1+\cos(60°+\propto))\div2\pi$
c) $3V_{ml}(1+\cos(60°+\propto))\div\pi$
d) $6V_{ml}(\cos(\propto))\div\pi$
Answer: c
Explanation: The output voltage of 3-Φ Full wave bridge rectifier for R load is $3V_{ml}(1+\cos(60°+\propto))\div\pi$ for α > 60°. Conduction will only remain from 60°+α to 180°.

29. In a resistance firing circuit the firing angle
a) cannot be greater than 120°
b) cannot be greater than 90°
c) cannot be greater than 180°
d) cannot be greater than 160°
Answer: b
Explanation: The R firing circuits cannot be used for alpha greater than 90 degrees.

30.. For a R firing circuit, the maximum value of source voltage is 100 V. Find the resistance to be inserted to limit the gate current to 2 A.
a) 5 Ω
b) 50 Ω
c) 500 Ω
d) 0.5 Ω
Answer: b
Explanation: R = 100/2 = 50 Ohm.

31. The diode in the R firing circuit
a) ensures that the gate voltage is a half wave DC pulse
b) ensures that the gate voltage is a full wave DC pulse
c) ensures that the gate voltage is a half wave AC pulse
d) ensures that the gate voltage is a full wave AC pulse
Answer: b
Explanation: The diode is placed between the resistances and gate which ensures that the current flows in one direction only.

32. In case of an RC half wave triggering circuit, the firing angle can be ideally varied between
a) 0 to 180
b) 0 to 90
c) 0 to 120
d) 0 to 360
Answer: a
Explanation: Unlike the R firing circuit, the RC firing circuits can be used to obtain firing angle greater than 180. Although practically 0 and 180 degree is improbable.

33. The conduction period of diode in Half-wave uncontrolled rectifier for resistive load is _____

a) π
b) 2π
c) 3π
d) 4π
Answer: a
Explanation: The conduction period of the diode in Half-wave uncontrolled rectifier for the resistive load is π. For the negative A.C supply diode will be reverse biased.

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04- Choppers and Inverters	Marks:-14
Content of Chapter:- 4.1 Convertors and its types. 4.2 block diagram and working of step up and step down choppers using power MOSFET 4.3 Inverters : circuits diagram, working of series inverter,parallel inverter.	

1. A three phase full converter will require _____ number of SCRs.
a) 3
b) 6
c) 9
d) 2
Answer: b
Explanation: Three legs having two SCRs each, six in total.

2. A three phase six pulse full converter works as a ac to dc converter for firing angles in the range
a) $\alpha > 90$
b) $90 < \alpha < 180$
c) $0 < \alpha < 90$
d) $0 < \alpha < 360$
Answer: c
Explanation: When α is less than 90°, the SCRs conduct for 120° and the current and voltage are positive on an average hence, the power flows from AC source to DC load.

3. A three-phase, three-pulse, M-3 type controlled converter uses _____ number of SCRs.
a) 1
b) 2
c) 3
d) 4
Answer: c
Explanation: It uses three SCRs with a three-phase transformer. M-3 type 3-pulse converters are not practically used.

4. A three-phase, three-pulse, M-3 type controlled converter has firing angle for one of the SCRs set as 15°. This SCR would start conducting at
a) 0°
b) 15°
c) 30°
d) 45°
Answer: d
Explanation: In a three phase controller, the actually conduction starts at 30° + α. Hence, $\omega t = 30+15 = 45°$.

5. In a three-phase, three-pulse, M-3 type controlled converter T1 starts to conduct at 30 + n°. At what angles do T2 and T3 start to conduct? Assume that the conduction sequence is T1-T2-T3.
a) 2n° and 3n°
b) 150 + n° and 270 + n°
c) n° each
d) 30 + n° and 60 + n°
Answer: b
Explanation: In three-phase three pulse converter the conduction can start only after 30°. As each SCR conducts from 120°, T2 would conduct on 30+120+n° = 150+n° and so on.

6.In Half-wave controlled rectifier calculate the average value of the current for 2.5 Ω resistive load if the supply is sin(5.2t) and firing angle is 26°.
a) 0.8 V
b) 0.15 V
c) 0.12 V
d) 0.21 V
Answer: c
Explanation: In Half-wave controlled rectifier, the average value of the current is $V_m(1+\cos(\propto))\div 2\pi R=(1+\cos(26°))\div 6.28\times 2.5=.12$ V. The thyristor will conduct from $\propto$ to π.

7. For a step-up/step-down chopper, if α (duty cycle) < 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) none of the mentioned
Answer: b
Explanation: Vo = Vs (α/1-α)
For duty cycle is less than 0.5, the circuit behaves like a step down chopper. Hence, Vo < Vs.

8. A step-down chopper is also called as a
a) first-quadrant chopper
b) second-quadrant chopper
c) third-quadrant chopper
d) fourth-quadrant chopper
Answer: a
Explanation: It is called as a first quadrant chopper as the current always flows from source to load and the current and voltage both are always positive.

9. The type-C chopper or two quadrant type-A chopper has
a) type-A and type-B choppers in series
b) type-A and type-B choppers in parallel
c) two type-A choppers in series
d) two type-A choppers in parallel
Answer: b
Explanation: The type-C chopper is a two quadrant chopper, it operates in the 1st and the 2nd quadrant. It has type-A and type-B choppers connected in parallel.

10. The expression for a step-up/step-down chopper with α as the duty cycle and Vs as the dc input voltage is
a) Vs/1 – α
b) α x Vs
c) Vs (α/1-α)
d) Vs (α/1+α)
Answer: c
Explanation: A step-up, step-down chopper can behave as a step up chopper for α > 0.5 and step –down chopper for α < 0.5.

11. For a step-up/step-down chopper, if the duty cycle > 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) None of the mentioned
Answer: c
Explanation: Vo = Vs (α/1-α)
For α is greater than 0.5, the chopper behaves as a step-up chopper. Hence, Vo > Vs.

12. For a step-up/step-down chopper, if α (duty cycle) = 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) none of the mentioned
Answer: a
Explanation:
Vo = Vs (α/1-α)
For α = 0.5
Vo = Vs x (0.5/0.5).

13. If a step up chopper's switch is always kept off then (ideally)
a) Vo = 0
b) Vo = ∞
c) Vo = Vs
d) Vo > Vs
Answer: c
Explanation: If it is said the a chopper is always kept off, that means the switch is always open. As such,
Ton = 0
Duty cycle = 0
Vo = Vs/1-duty cycle . . . (for a step-up chopper).

14. If a step up chopper's switch is always kept open then (ideally)
a) Vo = 0
b) Vo = ∞
c) Vo = Vs
d) Vo > Vs
Answer: b
Explanation: If it is always in then, Ton = T. Duty cycle = 1.
Vo = Vs/1-duty cycle = Vs/0
Therefore, Vo = ∞.

15. For a step-up chopper, when the duty cycle is increased the average value of the output voltage
a) increases
b) decreases
c) remains the same
d) none of the mentioned
Answer: a
Explanation: Vo = Vs/1-duty cycle
Hence, as duty cycle increases the output voltage increases.

16. For a step-down chopper, when the duty cycle is increased the average value of the output voltage
a) increases
b) decreases
c) remains the same
d) none of the mentioned
Answer: a
Explanation: Vo = Duty cycle x Vs. Hence, output voltage is directly proportional to the duty cycle.

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

18. 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.

19. 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
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.

20. Which device can be used in a chopper circuit?
a) BJT
b) MOSFET
c) GTO
d) All of the mentioned
Answer: d

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

21. 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.

22. What is the duty cycle of a chopper ?
a) Ton/Toff
b) Ton/T
c) T/Ton
d) Toff x Ton
Answer: b
Explanation: It is the time during which the chopper is on (Ton) relative to the whole period (T = Ton+Toff).

23. The load voltage of a chopper can be controlled by varying the
a) duty cycle
b) firing angle
c) reactor position
d) extinction angle
Answer: a
Explanation: The output voltage can be changed by changing the duty cycle (Ton/T).

24. The values of duty cycle (α) lies between
a) 0<α<1
b) 0>α>-1
c) 0<=α<=1
d) 1<α<100
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.

25. If T is the time period for a chopper circuit and α is its duty cycle, then the chopping frequency is
a) Ton/α
b) Toff/α
c) α/Toff
d) α/Ton
Answer: d
Explanation: α = Ton/T
T = Ton/ α
f = 1/T = α/Ton.

26. Find the output voltage expression for a step down chopper with Vs as the input voltage and α as the duty cycle.
a) Vo = Vs/α
b) Vo = Vs x α
c) Vo = Vs^2/α
d) Vo = 2Vs/απ
Answer: b
Explanation: The chopper output voltage is Duty cycle x the input voltage (ideal condition).

27. If V1 and V2 are the converter output voltages then the reactor voltage is
a) V1 + V2
b) V1 – V2
c) V1 x V2
d) none of the mentioned
Answer: b
Explanation: The reactor voltage Vr is the difference of the converter output voltages.

28. The expression for a step-up/step-down chopper with α as the duty cycle and Vs as the dc input voltage is
a) Vs/1 – α
b) α x Vs
c) Vs (α/1-α)
d) Vs (α/1+α)
Answer: c
Explanation: A step-up, step-down chopper can behave as a step up chopper for α > 0.5 and step –down chopper for α < 0.5.

29. For a step-up/step-down chopper, if the duty cycle > 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) None of the mentioned
Answer: c
Explanation: Vo = Vs (α/1-α)
For α is greater than 0.5, the chopper behaves as a step-up chopper. Hence, Vo > Vs.

30. A step down chopper has Vs = 230 V and R = 10 Ω. For a duty cycle of 0.4, the power taken by the chopper is 2097 Watts. Find the chopper efficiency. Take the voltage drop across the chopper switch as 2 V.
a) 98 %
b) 89.96 %
c) 99.14 %
d) 96.54 %
Answer: c
Explanation: Vo (rms) = $\sqrt{0.4}$ x (230 – 2) = 144.2 V
Po = $144.2^2/10$ = 2079.3 Watts
Pi = 2097 Watts
η = Po/Pi = 99.14 %.

31. A step down chopper has input dc voltage of 220 V and R = 10 Ω in series with L = 65 mH. If the load current varies linearly between 11 A and 17 A, then find the duty cycle α.
a) 1
b) 0.4
c) 0.6
d) 0.7
Answer: d
Explanation: Average load current = 11+17 / 2 = 14A
Average load voltage = IxR = 14×10 = 140V
But, Vo = α x Vs
Therefore, α x 220 = 140, α = 0.7.

32. For a step-up/step-down chopper, if α (duty cycle) = 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) none of the mentioned
Answer: a
Explanation:
Vo = Vs (α/1-α)
For α = 0.5
Vo = Vs x (0.5/0.5).

33. For a step-up/step-down chopper, if α (duty cycle) < 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) none of the mentioned
Answer: b
Explanation: Vo = Vs (α/1-α)
For duty cycle is less than 0.5, the circuit behaves like a step down chopper. Hence, Vo < Vs.

34. A step-down chopper is also called as a
a) first-quadrant chopper
b) second-quadrant chopper
c) third-quadrant chopper
d) fourth-quadrant chopper
Answer: a
Explanation: It is called as a first quadrant chopper as the current always flows from source to load and the current and voltage both are always positive.

35. The type-C chopper or two quadrant type-A chopper has
a) type-A and type-B choppers in series
b) type-A and type-B choppers in parallel
c) two type-A choppers in series
d) two type-A choppers in parallel
Answer: b
Explanation: The type-C chopper is a two quadrant chopper, it operates in the 1st and the 2nd quadrant. It has type-A and type-B choppers connected in parallel.

36. In voltage source inverters (VSIs), the amplitude of the output voltage is
a) independent of the load
b) dependent on the load
c) dependent only on L loads
d) none of the mentioned
Answer: a
Explanation: In VSIs the input voltage is maintained at a constant value and the amplitude of the output voltage does not depend on the load conditions. However, the waveform of the load current as well as its magnitude depends upon the nature of the load impedance.

37. In voltage source inverters (VSIs), the output currents _____
a) amplitude depends upon the load impedance
b) waveform depends upon the load impedance
c) amplitude as well as the nature of the waveform depends on the load
d) both amplitude and waveform are independent of the load impedance
Answer: c
Explanation: In VSIs the input voltage is maintained at a constant value and the amplitude of the output voltage does not depend on the load conditions. However, the waveform of the load current as well as its magnitude depends upon the nature of the load impedance.

38. In current source inverters (CSIs)
a) the amplitude of the output current is independent of the load
b) the amplitude of the output current dependents on the load
c) the amplitude of the output voltage is independent of the load
d) none of the mentioned
Answer: a
Explanation: In CSIs, the amplitude of the output current is independent on the load impedance, as the input current (to the CSI) is kept constant.

39. In current source inverters (CSIs), the output voltage's
a) amplitude depends upon the load impedance
b) waveform depends upon the load impedance
c) amplitude as well as the nature of the waveform depends on the load
d) both amplitude and waveform are independent of the load impedance
Answer: c
Explanation: In CSIs, the amplitude of the output current is independent on the load impedance, as the input current (to the CSI) is kept constant. However, the magnitude of output voltage and its waveform depends upon the nature of the load impedance.

40. In current source inverters
a) L filter is used after the CSI (load side)
b) L filter is used before the CSI (input side)
c) C filter is used after the CSI (load side)
d) C filter is used before the CSI (input side)
Answer: b
Explanation: In order that the current input to the CSI must remain ripple free an constant, L-filter is used before the CSI (in series with the energy source).

41. A CSI converters
a) the input dc current to an an current at output
b) the input ac current to dc current at output
c) the input dc current to amplified dc current at the output
d) the input ac current to amplified ac current at the output
Answer: a
Explanation: CSI converts the input dc current to an ac current at its output terminals.

42. The external control of ac output voltage can be achieved in an inverter by
a) connecting a cyclo-converter
b) connecting an ac voltage controller between the output of the inverter and the load
c) connecting an ac voltage controller between the dc source and inverter
d) connecting an ac voltage controller between the load and the dc source
Answer: b
Explanation: By connecting a AC voltage controller, the ac output from the inverter can be varied and then fed to the load.

43. The series-inverter control method is a/an
a) internal voltage control method
b) external frequency control method
c) external voltage control method
d) none of the mentioned
Answer: c
Explanation: It is a external voltage control method where the outputs of the two inverters are connected to the transformers where the secondary of the transformer sums up the two input voltages.

44. In the series-inverter control method
a) two inverters are connected back-to-back
b) the output from the inverter is taken serially
c) output voltages of two inverters are summed up with the help of a transformer
d) output voltages of two inverters are summed up with the help of a third inverter
Answer: c
Explanation: It is a external voltage control method where the outputs of the two inverters are connected to the transformers where the secondary of the transformer sums up the two input voltages.

45. _____ method is an internal method for controlling the inverter output voltage.
a) series connection of inverters
b) chopper method
c) commutating capacitor
d) pulse width modulation
Answer: d
Explanation: The PWM method, (pulse width modulation method) is an internal controlling method

46. Choppers convert _____
a)AC to DC
b)DC to AC
c)DC to DC
d)AC to AC
Ans : b)DC to AC

47.In the _____ type of chopper ,two stage conversations takes place .
a) AC-DC
b)AC link
c)DC link
d)none of the mentioned
Ans: a) AC-DC

48.What is the duty cycle of chopper
a)Ton/Toff
b)Ton/T
C)T/Ton
d)Toff+Ton
Ans : b)Ton/T

49._____based inverters donot require seldf communications
a)IGBT
b)GTO
c)PMOSFET
d)SCR
Ans: d)SCR

50.In single phase half wave inverter _____ SCR are gated at a time
a)one
b)two
c)three
d)none of the mentioned
Ans : a)one

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05 – Industrial applications of power electronic devices	Marks:-10
Content of Chapter: - 5.1 Light dimmer circuit using DIAC-TRIAC 5.2 Battery charger using SCR 5.3 Emergency lighting system 5.4 Temperature controller using SCR. 5.5 Block diagram and concept of UPS (on line and off line) 5.6 block diagram and concept of SMPS.	

1. For high power applications _____ are used as static switches whereas for low power applications _____ are used.
a) Transistors, SCRs
b) SCRs, transistors
c) Diodes, transistors
d) SCRs, diodes
Answer: b
Explanation: As SCR are of higher rating they are preferred in high power applications.

2. _____ can be used as a single phase static ac switch.
a) Diode
b) SCR
c) DIAC
d) TRAIC
Answer: d
Explanation: SCR cannot be used, as it is unidirectional. Diode isn't a switch nor is the DIAC.

3. _____ can be used as a dc static switch.
a) GTO
b) Transistor
c) Both GTO and transistor
d) TRIAC
Answer: c
Explanation: Both GTO and transistor can be used as a dc static switch.

4. Solid State Relays (SSRs) have
a) moving parts
b) no moving parts
c) a coil
d) a contactor
Answer: b
Explanation: SSRs have no moving parts, they simply consist of a LED and a transistor or photo diode.

5. SMPS is used for
a) obtaining controlled ac power supply
b) obtaining controlled dc power supply
c) storage of dc power
d) switch from one source to another
Answer: b
Explanation: SMPS (Switching mode power supply) is used for obtaining controlled dc power supply.

6. SPMS are based on the _____ principle.
a) Phase control
b) Integral control
c) Chopper
d) MOSFET
Answer: c
Explanation: SMPS (Switching mode power supply) are based on the chopper principle. The output dc voltage is controlled by varying the duty cycle of the chopper circuit.

7. Choose the incorrect statement.
a) SMPS is less sensitive to input voltage variations
b) SMPS is smaller as compared to rectifiers
c) SMPS has low input ripple
d) SMPS is a source of radio interference
Answer: c
Explanation: SMPS has higher output ripple and its regulation is worse.

8. _____ is used for critical loads where temporary power failure can cause a great deal of inconvenience.
a) SMPS
b) UPS
c) MPS
d) RCCB
Answer: b
Explanation: Uninterruptible Power Supply is used where loads where temporary power failure can cause a great deal of inconvenience.

9. _____ is used in the rotating type UPS system to supply the mains.
a) DC motor
b) Self excited DC generator
c) Alternator
d) Battery bank
Answer: c
Explanation: When the supply is gone, the diesel engine is started, which runs the alternator and the alternator supplies power to the mains. Non-rotating type UPS are not used anymore.

10. Static UPS requires _____
a) only rectifier
b) only inverter
c) both inverter and rectifier
d) none of the mentioned
Answer: c
Explanation: Rectifier to converter the dc from the battery to ac. Inverter to charge the battery from mains.

11. No discontinuity is observed in case of
a) short break static UPS configuration
b) long break static UPS configuration
c) no break static UPS configuration
d) rotating type UPS configuration
Answer: c
Explanation: No dip or discontinuity is observed in case of no break static UPS configuration, as the battery inverter set immediately takes over the mains.

12. Usually _____ batteries are used in the UPS systems.
a) NC
b) Li-On
c) Lead acid
d) All of the mentioned
Answer: c
Explanation: Lead acid batteries are cheaper and have certain advantages over the other types. NC batteries would however be the best, but are three to four times more expensive than Lead Acid.

13. HVDC transmission has _____ as compared to HVAC transmission.
a) smaller transformer size
b) smaller conductor size
c) higher corona loss
d) smaller power transfer capabilities
Answer: b
Explanation: The conductor size is smaller as there is no sink effect, and the whole conductor is utilized for transmitting power.

14. The negative polarity is used in the monopolar link because it
a) uses less conductor size
b) is safer
c) produces less radio interference
d) has less resistance
Answer: c
Explanation: The monopolar link uses just a single conductor, which is usually negative as it produces less radio interference and corona.

15. SMPS is used for
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b) obtaining controlled dc power supply
c) storage of dc power
d) switch from one source to another
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Explanation: SMPS (Switching mode power supply) is used for obtaining controlled dc power supply.

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Explanation: Uninterruptible Power Supply is used where loads where temporary power failure can cause a great deal of inconvenience.

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d) Battery bank

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b) only inverter
c) both inverter and rectifier
d) none of the mentioned
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Explanation: Rectifier to converter the dc from the battery to ac. Inverter to charge the battery from mains.

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a) short break static UPS configuration
b) long break static UPS configuration
c) no break static UPS configuration
d) rotating type UPS configuration

Answer: c
Explanation: No dip or discontinuity is observed in case of no break static UPS configuration, as the battery inverter set immediately takes over the mains.

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Explanation: The conductor size is smaller as there is no sink effect, and the whole conductor is utilized for transmitting power.

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a) uses less conductor size
b) is safer
c) produces less radio interference
d) has less resistance
Answer: c
Explanation: The monopolar link uses just a single conductor, which is usually negative as it produces less radio interference and corona.

25.For high power applications _____ are used as static switches whereas for low power applications _____ are used.
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b) SCRs, transistors
c) Diodes, transistors
d) SCRs, diodes
Answer: b
Explanation: As SCR are of higher rating they are preferred in high power applications.

26._____ can be used as a single phase static ac switch.
a) Diode
b) SCR
c) DIAC
d) TRAIC

Answer: d
Explanation: SCR cannot be used, as it is unidirectional. Diode isn't a switch nor is the DIAC.

28. _____ can be used as a dc static switch.
a) GTO
b) Transistor
c) Both GTO and transistor
d) TRIAC
Answer: c
Explanation: Both GTO and transistor can be used as a dc static switch.

29 A single-phase ac switch is used in between a 230 V source and load of 2 kW and 0.8 lagging power factor. Determine the rms current rating required by the SCR. Use the factor of safety = 2.
a) 10.87 A
b) 87 A
c) 21.74 A
d) 32 A

30. Solid State Relays (SSRs) have
a) moving parts
b) no moving parts
c) a coil
d) a contactor
Answer: b
Explanation: SSRs have no moving parts, they simply consist of a LED and a transistor or photo diode.

31. TRIAC is used in
a) chopper
b) speed control of induction machine
c) speed control of universal motor
d) none of the mentioned
Answer: c
Explanation: TRIAC is used in speed control of universal motor.

32The ratio V_{rms}/ V_{dc} is known as
a) Form factor
b) Ripple factor
c) Utilization factor
d) None of the mentioned

Answer: a
Explanation: V_{rms}/ V_{dc} = FF.

33.SMPS stands for
a)small mode power supply
b)simple mode power supply
c)switch mode power supply
d)slow mode power supply
Answer: c

34.SMPS is used to
a)obtaining controlled ac power supply
b)storage of dc power
c)obtaining controlled dc power supply
d)switching from one source to another
Answer: c

35.Usually _____batteries used in the UPS system

a)NC
b)Lead acid
c)Li-on
d)all above mentioned
Ans: b) Lead acid

36.Ionization in circuit breakers is facilitated by
a)Inscrese the field if strength
b) Inscrese the mean of free path
c)High temperature

37.The ratio of Vrms/Vdc is known as
a)Form factor
b)Utilization factor
c)ripple factor
d)None of the mentioned
Ans : a)Form factor

38.TRIAC is used in
a)Chopper
b)speed control of induction machine
c)speed control of universal motor
d)none of the mentioned
Ans : c)speed control of universal motor

39.The factor goverening the induction heating are
a)Resistivity
b)Relative permeability
c)magnetic field intensity
d)all the mentioned
Ans: d)all the mentioned

40.Induction heating is the_____ type of heating
a)Zero frequency
b)High frequency
c)power frequency
d)none of the mentioned
Ans: c)power frequency

41.Solid state relay have
a) Moving parts
b) no moving parts
c)a coil
d)a connector
Ans: b) no moving parts

42._____ can be used as adc static switch
a)GTO
B)Transistor
c)both GTO and transister
d)TRIAC
Ans: d)TRIAC

43._____ can be used as asingle phase static ac switch
a)Diode
b)SCR
c)TRIAC
d)DIAC
Ans : c)TRIAC

44.For high power application_____ are used as static switch where as for low power application
a) Transistor, SCRs
b) SCRs, transistors
c) Diode, transistors
d) SCRs, diode
Ans: a)Transistor, SCRs

45.In HVDC transmission lines
a) both the station operate as an inverter
b) both the station operate as an converter
c) one acts as a converter and other as an inverter
d) depend upon the type of load
Ans : c) one acts as a converter and other as an inverter

46.HVDC transmission lines are _____as compared to HVAC lines
a) difficult to erect
b)more expensive for long distances
c) more expensive for short distances
d) less expensive for short distances
Ans : c) more expensive for short distances

47.Static UPS required _____
a) Only rectifier
b) Only inverter
c) Both inverter and rectifier
d)none of the mentioned
Ans: c) Both inverter and rectifier

48: _____ is used in rotating type ups system to supply the mains
a) DC motor
b) Self-excited DC generator
c) Alternator
d)Battery rank
Ans : c) Alternator

49. Smps is based on _____ principle
a) phase control
b) Integral control
c) chopper
d)MOSFET
Ans : c) chopper

50.The AC voltage controllers are used in _____applications
a) Power gerreation
b) Electric heating
c) Conveyot belt motion
d) power transmission
Ans : b) Electric heating

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