Subject: - Basic Power Electronics (22427)

SYLLABUS

Chapter No.	Name of chapter	Marks With Option
1	Thyristor family devices	32
2	Turn ON and Turn Off method of SCR	14
3	Phase controlled rectifiers	26
4	Choppers and Inverters	12
5	Industrial applications of power electronics devices	16
	Total Marks :-	100

BOARD THEORY PAPER PATTERN FOR BPE (22427)

Q.1		**Attempt any FIVE**	**5*2=10**
	a)	Choppers and Inverters	
	b)	Turn ON and Turn Off method of SCR	
	c)	Turn ON and Turn Off method of SCR	
	d)	Thyristor family devices	
	e)	Phase controlled rectifiers	
	f)	Thyristor family devices	
	g)	Industrial applications of power electronics devices	
Q.2		**Attempt any THREE**	**3*4=12**
	a)	Choppers and Inverters	
	b)	Thyristor family devices	
	c)	Turn ON and Turn Off method of SCR.	
	d)	Phase controlled rectifiers	
Q.3		**Attempt any THREE**	**3*4=12**
	a)	Industrial applications of power electronics devices	
	b)	Thyristor family devices	
	c)	Phase controlled rectifiers	
	d)	Thyristor family devices	
Q.4		**Attempt any FOUR**	**3*4=12**
	a)	Phase controlled rectifiers	
	b)	Thyristor family devices	
	c)	Industrial applications of power electronics devices	

	d)	Thyristor family devices
Q.5		**Attempt any TWO** **2*6=12**
	a)	Phase controlled rectifiers
	b)	Turn ON and Turn Off method of SCR
	c)	Thyristor family devices
Q.6		**Attempt any TWO 2*6=12**
	a)	Industrial applications of power electronics devices
	b)	Phase controlled rectifiers.
	c)	Choppers and Inverters

CLASS TEST - I

PAPER PATTERN

COURSE: - Basic Power Electronics (22427)

PROGRAMME: - E & TC Engineering

Syllabus: -

Unit No.	Name of the Unit	Course Outcome (CO)
1	**Thyristor family devices**	**CO427.1**
2	**Turn ON and Turn Off method of SCR**	**CO427.2**

Q.1	Attempt any FOUR4*2=8Marks	Course Outcome (CO)
a)	Thyristor family devices	CO427.1
b)	Turn ON and Turn Off method of SCR	CO427.2
c)	Thyristor family devices	CO427.1
d)	Turn ON and Turn Off method of SCR	CO427.2
e)	Turn ON and Turn Off method of SCR	CO427.2
f)	Thyristor family devices	CO427.1
Q.2	**Attempt any THREE3*4=12 Marks**	
a)	Thyristor family devices	CO427.1
b)	Turn ON and Turn Off method of SCR	CO427.2
c)	Thyristor family devices	CO427.1
d)	Thyristor family devices	CO427.1
e)	Turn ON and Turn Off method of SCR	CO427.2
f)	Turn ON and Turn Off method of SCR	CO427.2

CLASS TEST - II

PAPER PATTERN

COURSE: - Basic Power Electronics (22427)

PROGRAMME: - E & TC Engineering

Syllabus: -

Unit No.	Name of the Unit	Course Outcome (CO)
3	**Phase controlled rectifiers**	**CO427.3**
4	**Choppers and Inverters**	**CO427.4**
5	**Industrial applications of power electronics devices**	**CO427.5**

Q.1	Attempt any FOUR 4*2=8Marks	Course Outcome (CO)
a)	Phase controlled rectifiers	CO427.3
b)	Choppers and Inverters	CO427.4
c)	Phase controlled rectifiers	CO427.3
d)	Choppers and Inverters	CO427.4
e)	Industrial applications of power electronics devices	CO427.5
f)	Industrial applications of power electronics devices	CO427.5
Q.2	**Attempt any THREE 3*4=12 Marks**	
a)	Phase controlled rectifiers	CO427.3
b)	Choppers and Inverters	CO427.4
c)	Industrial applications of power electronics devices	CO427.5
d)	Choppers and Inverters	CO427.4
e)	Industrial applications of power electronics devices	CO427.5
f)	Phase controlled rectifiers	CO427.3

COURSE OUTCOME (CO)

COURSE: - Basic Power Electronics (22427)

PROGRAMME: - EJ

CO.NO	Course Outcome
CO-427.1	Identify power electronic devices in circuits
CO-427.2	Maintain triggering and commutation circuits.
CO-427.3	Use phase controlled rectifiers in different applications.
CO-427.4	Use choppers and inverters in different applications.
CO-427.5	Maintain Control Circuits consisting of power electronic devices

1. Thyristor Family Devices

Position in Question Paper **Total Marks-32**

Q.1. d) 2-Marks.
Q.1. f) 2-Marks.
Q.2. b) 4-Marks.
Q.3. b) 4-Marks.
Q.3. d) 4-Marks.
Q.4. b) 4-Marks.
Q.4. d) 4-Marks.
Q.5. c) 6-Marks.

Descriptive Question

1. Describe the construction of IGBT
2. State any two advantages of IGBT.
3. List two applications of TRIAC.
4. Sketch equivalent circuit of SCR using BJT. Describe its working principle.
5. Differentiate SCR and TRIAC with respect to (i) symbol, (ii) layered diagram, (iii) Operating quadrant, (IV) application.
6. Draw constructional diagram of GTO and state its operating principle.
7. Draw symbol and characteristics of DIAC and SUS.
8. Describe the working of DC flasher circuit using SCR with neat diagram.
9. State two applications each for (i) SCR and (ii) PUT.
10. Draw the symbols of (i) SCR (ii) DIAC
11. Define holding and latching current.
12. Compare SCR & TRIAC. (Any four points)
13. Draw and explain the VI characteristics of UJT.
14. Draw and explain the VI characteristics of SCR.
15. Draw the construction of GTO & explain the working principle.

16. Draw and explain the two transistor analogy of SCR.
17. Draw the structural diagram and symbol of SCR.
18. Draw the characteristics and explain the working of SCS.
19. Explain the working of "PUT" with relevant diagrams. Why it is called Programmable?
20. Name any four triggering devices. Draw the characteristics of "DIAC
21. With necessary waveforms explain the turn-off mechanism of SCR.
22. Name any two triggering devices used for triggering SCR.

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MCQ Question

(Total number of Question=Marks*3=18*3=54)

Note: Correct answer is marked with **bold**

1. 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
2. _____terminal does not belong to the SCR?
   a) Anode
   b) Gate
   c) Base
   d) Cathode
3. 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, and single junction device
4. 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
5. 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
6. 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
7. 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 bias

8. 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
9. With the anode positive with respect to the cathode & the gate circuit open, the SCR is said to be in
   a) Reverse blocking mode
   b) reverse conduction mode
   c) **forward blocking mode**
   d) forward conduction mode
10. 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
11. The GTO (gate turn-off Thyristors) is a
   a) **p-n-p-n device**
   b) p-n-p device
   c) p-metal-n device
   d) p-n single junction device
12. 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
13. 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
14. The forward break over voltage is the
   a) anode-cathode voltage at which conduction starts with gate signal applied
   b) **anode-cathode voltage at which conduction starts with no gate signal applied**
   c) gate voltage at which conduction starts with no anode-cathode voltage
   d) gate voltage at which conduction starts with anode-cathode voltage applied
15. For a forward conducting SCR device, as the forward anode to cathode voltage is increased
   a) the device turns on at higher values of gate current
   b) **the device turns on at lower values of gate current**
   c) the forward impedance of the device goes on increasing
   d) the forward impedance of the device goes on decreasing

16. A thyristor can be bought from the forward conduction mode to forward blocking mode
    a) the dv/dt triggering method
    b) applying a negative gate signal
    c) applying a positive gate signal
    d) applying a reverse voltage across anode-cathode terminals
17. Usually the forward voltage triggering method is not used to turn-on the SCR because
    a) it increases losses
    b) it causes noise production
    c) **it may damage the junction & destroy the device**
    d) relatively it's an inefficient method
18. Among the following, the most suitable method to turn on the SCR device is the
    a) **gate triggering method**
    b) dv/dt triggering method
    c) forward voltage triggering method
    d) temperature triggering method
19. The forward break over voltage is maximum when
    a) Gate current = ∞
    b) **Gate current = 0**
    c) Gate current = -∞
    d) It is independent of gate current
20. For the SCR to remain in the ON (conducting) state
    a) gate signal is continuously required
    b) **no continuous gate signal is required**
    c) no forward anode-cathode voltage is required
    d) negative gate signal is continuously required
21. The value of anode current required to maintain the conduction of an SCR even though the gate signal is removed is called as the
    a) Holding current
    b) **latching current**
    c) switching current
    d) peak anode current
22. In the reverse blocking mode the middle junction (J_2) has the characteristics of that of
    a) Transistor
    b) **capacitor**
    c) Inductor
    d) none of the mentioned
23. _____are semiconductor Thyristor devices which can be turned-on by light of appropriate wavelengths.
    a) LGTOs
    b) LASERs
    c) MASERs
    d) **LASCRs**

24. The minimum value of anode current below which it must fall to completely turn-off the device is
   a) **Holding current value**
   b) latching current value
   c) switching current value
   d) peak anode current value

25. The latching current is _____ than the holding current
   a) Lower
   b) **Higher**
   c) same as
   d) negative of

26. 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

27. To avoid commutation failure
   a) **circuit turn-off time must be greater than the thyristors 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 thyristors turn-off time
   d) none of the above mentioned

28. The gate characteristics of thyristors 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

29. The area under the curve of the gate characteristics of thyristors gives the
   a) Total average gate current
   b) total average gate voltage
   c) total average gate impedance
   d) **total average gate power dissipation**

30. A tangent drawn from the Y-axis to the Pavg on the gate characteristics gives the value of the
   a) Maximum value of gate-source resistance
   b) **minimum value of gate-source resistance**
   c) maximum value of gate-source power
   d) minimum value of gate-source power

31. Higher the magnitude of the gate pulse
   a) **lesser is the time required to inject the charges**
   b) greater is the time required to inject the charges
   c) greater is the value of anode current

d) lesser is the value of anode current

32. For an SCR, the gate-cathode characteristic has a slop of 130. The gate power dissipation is 0.5 watts. Find Ig

a) 0.62 A
b) 620 mA
c) **62 mA**
d) 6.2 mA

33. The two transistor model of the SCR can obtained by

a) bisecting the SCR vertically
b) bisecting the SCR horizontally
c) bisecting the SCRs top two & bottom two layers
d) **bisecting the SCRs middle two layers**

34. Latching current for an SCR is 100 mA, DC source of 200 V is also connected from the SCR to the L load. Compute the minimum width of the gate pulse required to turn on the device. Take L = 0.2 H.

a) 50 µsec
b) **100 µsec**
c) 150 µsec
d) 200 µsec

35. Latching current for an SCR is 100 mA, a dc source of 200 V is also connected to the SCR which is supplying an R-L load. Compute the minimum width of the gate pulse required to turn on the device. Take L = 0.2 H & R = 20 ohm both in series.

a) 62.7 µsec
b) **100.5 µsec**
c) 56.9 µsec
d) 81 µsec

36. The voltage safety factor (V_{SF}) for an SCR is the ratio of

a) peak working voltage & peak reverse repetitive voltage
b) dv/dt & di/dt
c) **peak repetitive reverse voltage & maximum value of input voltage**
d) peak repetitive reverse voltage & rms value of input voltage

37. The forward dv/dt rating of an SCR

a) **increases with increase in the junction temperature**
b) decreases with increase in the junction temperature
c) increases with decrease in the rms value of forward anode-cathode voltage
d) decreases with decrease in the rms value of forward anode-cathode voltage

38. The finger voltage of an SCR is

a) **minimum value of Vak to turn on the device with gate triggering**
b) maximum value of Vak to turn on the device with gate triggering
c) minimum value of Vak to turn on the device without gate triggering
d) maximum value of Vak to turn on the device without gate triggering

39. Which among the following anode current waveforms will have the minimum junction temperature?

a) 100 % DC
b) **25 % DC**
c) 50 % DC
d) AC

40. An SCR has half cycle surge current rating of 3000 A for 50 Hz. Calculate its one-cycle

a) 3121.32 A
b) **2121.32 A**
c) 3131.32 A
d) 2131.32 A

41. For a SCR the maximum rms on-state current is 35 A. If the SCR is used in a resistive circuit for a rectangular wave with conduction angle of 90°. Calculate the average & rms currents respectively.

a) **I/4, I/2**
b) I/2, I/√2
c) I/4, $I^2/2$
d) I/4, I/√2

42. The thermal resistance between junction & the SCR (θ_{jc}) has the unit

a) **Ω**/°C
b) W/**Ω**
c) **°C/W**
d) **Ω**W/°C

43. 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

44. 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

45. The effect of over-voltages on SCR are minimized by using

a) RL circuits
b) Circuit breakers
c) **Varistors**
d) di/dt inductor

46. 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

47. _____ 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

48. 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

49. 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

50. 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

51. 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

2. Turn On & Turn Off methods of SCR

Position in Question Paper **Total Marks-14**

Q.1. b) 2-Marks.
Q.1. c) 2-Marks.
Q.2. c) 4-Marks.
Q.5. b) 6-Marks.

Descriptive Question

1. State difference between forced commutation and natural commutation.
2. State different trigger methods and describe R-triggering method.
3. Explain dv/dt turn on method of SCR.
4. Draw the layer diagram of PUT. With neatcircuit diagram, describe its Working as relaxation oscillator
5. Describe the working of class B commutation with neat circuit diagram.
6. Explain class C commutation with circuit diagram.
7. Compare R-triggering and RC-triggering of SCR
8. List different turn-on methods of SCR
9. Draw and explain the VI characteristics of DIAC.
10. Explain SCR triggering using UJT with neat circuit diagram.
11. Draw the neat block diagram of gate triggering. State the advantages of gateTriggering.
12. Describe the operation of pulse transformer used in triggering circuits.
13. Explain RC triggering circuit with neat circuit diagram & waveforms.
14. Define commutation. List various types of commutation.
15. List any four methods of triggering of SCR.

MCQ Question

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold**

1. The time constant of a series RC circuit (τ) is given by
   a) R/C
   b) C/R
   c) **RC**
   d) 1/RC
2. The time constant of a series RL circuit (τ) is given by
   a) **R/L**
   b) L/R
   c) RC
   d) 1/RL
3. In a single pulse semi-converter using two SCRs, the triggering circuit must produce
   a) Two firing pulses in each half cycle
   b) **one firing pulse in each half cycle**
   c) three firing pulses in each cycle
   d) one firing pulse in each cycle
4. In a 3-phase full converter using six SCRs, gating circuit must provide
   a) one firing pulse every 30°
   b) one firing pulse every 90°
   c) **one firing pulse every 60°**
   d) three firing pulses per cycle
5. In the complete firing circuit, the driver circuit consists of
   a) pulse generator & power supply
   b) gate leads & power supply
   c) **pulse amplifier & pulse transformer**
   d) pulse detector & pulse amplifier
6. The magnitude of gate voltage and gate current for triggering an SCR is
   a) **inversely proportional to the temperature**
   b) directly proportional to the temperature
   c) inversely proportional to the anode current requirement
   d) directly proportional to the anode current requirement
7. Find the triggering frequency when the average gate power dissipation = 0.3 W and the peak gate drive power is 5 Watts. The gate source has a pulse width of 20 μsec duration.
   a) **3 kHz**
   b) 0.3 kHz
   c) 30 kHz
   d) 0.03 mHz
8. The major function of the pulse transformer is to
   a) Increase the voltage amplitude
   b) reduce harmonics
   c) **isolate low & high power circuit**
   d) create periodic pulses
9. 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°

10. 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

11. 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

12. 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

13. In case of a R firing circuit with $V_{gp} > V_{gt}$
a) $\alpha = 90°$
b) $\alpha > 90°$
c) **$\alpha < 90°$**
d) $\alpha = 0°$

14. In case of an RC full wave firing circuit with R load, the voltage across the load is zero for_____
a) $\omega t = 0$ to α and $\omega t = \pi$ to $2\pi+\alpha$
b) **$\omega t = 0$ to α**
c) $\omega t = \pi$ to $2\pi+\alpha$
d) $\omega t = \alpha$ to 2π

15. For an RC full wave firing circuit the empirical formula for calculating the value of RC is
a) **$RC = 157/\omega$**
b) $RC = 157 \times \omega$
c) $RC = \omega/157$
d) $RC = 157 \times \omega^2$

16. Pulse triggering can be only used by the _____ type of triggering circuit
a) R
b) RC
c) **UJT**
d) RLC

17. The UJT terminals are
a) **E, B1 and B2**
b) E1, E2 and B
c) E, G and C
d) G, S and D

18. In case of the UJT firing circuit, when the UJT turns on
a) the capacitor starts to charge
b) **the capacitor starts to discharge**
c) the capacitor remains unaffected
d) there is no capacitor in a UJT firing circuit

19. In the UJT firing circuit, the pulses are generated while the
a) capacitor charges
b) **capacitor discharges**

c) capacitor voltage is zero
d) there is no capacitor in a UJT firing circuit

20. Find the value of the charging resistor in case of a UJT firing circuit with firing frequency of 2 kHz, C = 0.04 μF, η = 0.72
a) 5.62 kΩ
b) 37 kΩ
c) 4.23 kΩ
d) **9.82 kΩ**

21. 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

22. 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

23. 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

24. 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

25. 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

26. 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

27. If the gating circuits generator negative pulses, then those can be removed by using
a) Schmitt triggers
b) **clippers**
c) clampers
d) zener diodes

28. 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

29. 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

30. 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

31. 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**

32. The class A commutation or load commutation is possible in case of
a) **Dc circuit's only**
b) ac circuits only
c) both DC and AC circuits
d) none of the above mentioned

33. 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

34. 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

35. 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

36. 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**

37. 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) **commutation**

38._____commutation technique is commonly employed in series inverters.

a) Line
b) **load**
c) forced
d) external-pulse

39. 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**

40._____ commutation is usually used in phase-controlled rectifiers

a) **Line**
b) Load
c) Forced
d) external-pulse

41.Parallel-capacitor commutation is

a) Line commutation
b) load commutation
c) **forced commutation**
d) external-pulse commutation

42.Class E commutation is a/an

a) line commutation technique
b) load commutation technique
c) forced commutation technique
d) **external-pulse commutation technique**

3. Phase Control Rectifiers

Position in Question Paper **Total Marks-26**

Q.1. e) 2-Marks.
Q.2. d) 4-Marks.
Q.3. c) 4-Marks.
Q.4. a) 4-Marks.
Q.5. a) 6-Marks.
Q.6. b) 6-Marks.

Descriptive Question

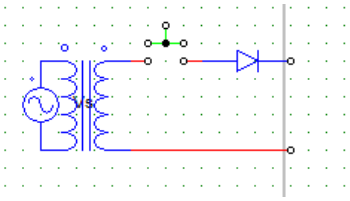
1. Define firing angle and conduction angle.
2. What is the polyphase rectifier? State its need
3. Draw the single phase full wave bridge type controlled rectifier.
4. Draw theWaveforms of input voltage, load voltage and voltage across SCR
5. Compare controlled and uncontrolled rectifiers.
6. Describe the effect of freewheeling diode in controlled rectifier.
7. Draw circuit diagram of single phase half bridge inverter. Explain its working with output voltage waveforms.
8. Draw 1phase HWCR with inductive load. Draw input and output waveforms.Describe its operation.
9. Draw the circuit diagram input-output waveforms and explain the working ofSingle phase half wave controlled rectifier with R load.
10. Draw the neat circuit diagram and waveforms of single phase center tappedFull wave controlled rectifier with RL load.
11. Define firing angle and conduction angle. What is the effect of firing angle onAverage output voltage?
12. Explain the operation of three phase half wave controlled rectifier.

MCQ Question

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold.**

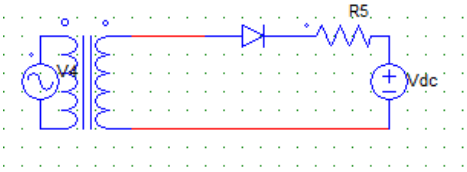
1. In a half-wave rectifier, the
   a) current & voltage both are bi-directional
   b) current & voltage both are uni-directional
   c) **current is always uni-directional but the voltage can be bi-directional or uni-directional**
   d) current can be bi-directional or uni-directional but the voltage is always uni-directional
2. For a single phase half wave rectifier, with R load, the diode is reversed biased from ωt
   a) 0 to π, 2π to 2π/3
   b) **π to 2π, 2π/3 to 3π**
   c) π to 2π, 2π to 2π/3
   d) 0 to π, π to 2π
3. In a 1-Phase HW diode rectifier with R load, the average value of load current is given by Take Input (Vs)
   a) Vm/R
   b) Vm/2R
   c) **Vm/πR**
   d) Zero
4. Find the average value of output current for a 1-phase HW diode rectifier with R load, RMS output current = 100A.
   a) 200R A
   b) 100/R√2 A
   c) 200/R√2 A
   d) 200/Rπ A
5. A 1-phase 230V, 1KW heater is connected across a 1-phase HW rectifier (diode based)
   a) 300 W
   b) 400 W
   c) **500 W**
   d) 600 W
6. A 1-phase half wave diode rectifier with R load, has input voltage of 240 V. The input power factor is
   a) Unity
   b) 0.707 lag
   c) **0.56 lag**
   d) 0.865 lag
7. A 1-phase half wave diode rectifier with R = 1 KΩ, has input voltage of 240 V. The diode peak current
   a) Zero
   b) 240mA
   c) 24mA
   d) 0.24mA
8. For the below given circuit, after the switch is closed the voltage across the load (shown open) remains constant.



Assuming that all initial conditions are zero. The element across the load would be a/an

a) Resistor
b) **Capacitor**
c) Inductor
d) data not sufficient

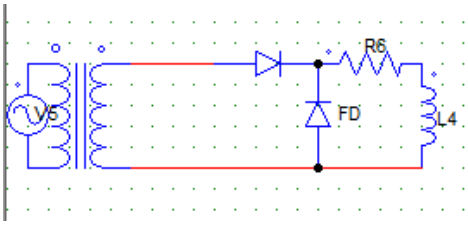
9. For the below given circuit,



After the supply voltage (Vs) is given the

a) diode starts conducting
b) **diode starts conducting only when Vs exceeds Vdc**
c) diode never conducts
d) diode stops conducting only when Vs exceeds Vdc

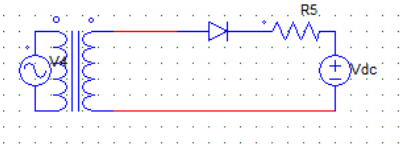
10. For the below given circuit,



With Vs = Vm sin ωt (secondary side). The expression for the average voltage is

a) Vm
b) Vm/2π
c) **Vm/π**
d) Vm/2

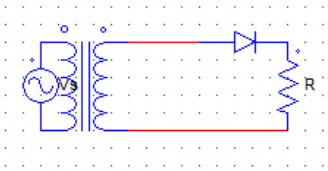
11. For the below given circuit, the



12. The voltage across phase angle is

a) Output voltage is never positive
b) output current is never positive
c) output current is never zero
d) output voltage is never zero

13. For the below given circuit,



Vs = 325 sin ωt (secondary side) The ripple voltage is

a) **125.32 V**
c) 325 V
b) 255.65 V
d) 459.12 V

14. For a single phase half wave rectifier, the rectifier efficiency is always constant & it is

a) 4/π2
c) 100
b) 8/π2
d) 2/π2

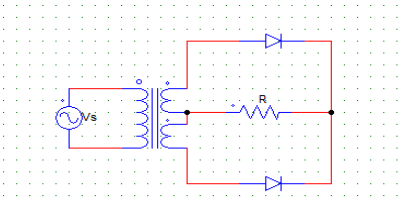
15. A single-phase full wave mid-point type diode rectifier requires _____ number of diodes whereas

a) 1, 2
c) 4, 8
b) **2, 4**
d) 3, 2

16. A single-phase full wave rectifier is a

a) Single pulse rectifier
c) **two pulse rectifier**
b) multiple pulse rectifier
d) three pulse rectifier

17. The below shown circuit is that of a

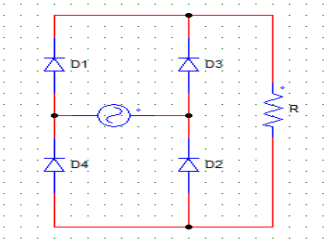


a) Full wave B-2 type connection
c) half wave B-2 type connection
b) **full wave M-2 type connection**
d) half wave M-2 type connection

18. In a 1-phase full wave bridge rectifier with M-2 type of connection has secondary side voltage Vs = Vm sin ωt, with R load & ideal diodes.The expression for the average value of the output voltage can be given by

a) **2Vm/π**
c) Vm/√2
b) Vm/π
d) 2Vm/√2

19. The below shown circuit is that of a



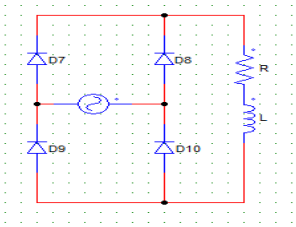
a) Full wave B-2 type connection
c) **half wave B-2 type connection**
b) full wave M-2 type connection
d) half wave B-2 type connection

20. In a 1-phase full wave bridge rectifier with M-2 type of connection has secondary side voltage Vs = Vm sin ωt, with R load & ideal diodes.The expression for the rms value of the output voltage can be given by
    a) Vm/π
    b) **Vm/√2**
    c) Vm
    d) Vm^2

21. The PIV experienced by the diodes in the mid-point type configuration is
    a) Vm
    b) **2Vm**
    c) 4Vm
    d) Vm/2

22. 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 continues conduction, the average and rms values of diode currents will be
    a) 7.85 A, 8 A
    b) 10.35 A, 7.85 A
    c) **10.35 A, 14.6 A**
    d) 8 A, 8 A

23. For the circuit shown below, the load current attains the maximum value at ωt =



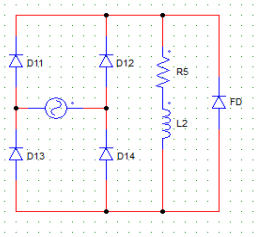
    a) 0
    b) **π**
    c) 2π
    d) none of the mentioned

24. 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

25. 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

26. 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

27. For the circuit shown below, D11 & D14 conduct from?



Assume that anode of D12 is positive at ωt = 0 and likewise.

a) 0 to π
b) **π to 2π**
c) 2π to 3π
d) 0 to π/2

28. In a single pulse semi-converter using two SCRs, the triggering circuit must produce
a) Two firing pulses in each half cycle
b) **one firing pulse in each half cycle**
c) three firing pulses in each cycle
d) one firing pulse in each cycle

29. In a 3-phase full converter using six SCRs, gating circuit must provide
a) one firing pulse every 30°
b) one firing pulse every 90°
c) **one firing pulse every 60°**
d) three firing pulses per cycle

30. In the complete firing circuit, the driver circuit consists of
a) Pulse generator & power supply
b) gate leads & power supply
c) **pulse amplifier & pulse transformer**
d) pulse detector & pulse amplifier

31. Find the average gate power dissipation (P_{gav}) when the maximum allowable gate power dissipation (P_{gm}) = 10 kW, with a duty cycle = 50 %.
a) 10 KW
b) **5 KW**
c) 2.5 KW
d) 7 KW

32. The magnitude of gate voltage and gate current for triggering an SCR is
a) **inversely proportional to the temperature**
b) directly proportional to the temperature
c) inversely proportional to the anode current requirement
d) directly proportional to the anode current requirement

33. Find the amplitude of the gate current pulse, when the gate-cathode curve is given by the relation Vg = [(1+10) x Ig] the peak gate drive power is 5 Watts.
a) 359mA
b) **659mA**
c) 1.359 A
d) 1.659 A

34. Find the triggering frequency when the average gate power dissipation = 0.3 W and the peak gate drive power is 5 Watts. The gate source has a pulse width of 20 μsec

duration.

a) **3 kHz**
c) 30 kHz
b) 0.3 kHz
d) 0.03 mHz

35. The duty cycle can be written as

a) **f x T**
c) T/f
b) f/T
d) f

36. The major function of the pulse transformer is to

a) Increase the voltage amplitude
c) **isolate low & high power circuit**
b) reduce harmonics
d) create periodic pulses

37. In a resistance firing circuit the firing angle

a) Cannot be greater than 120°
c) cannot be greater than 180°
b) **cannot be greater than 90°**
d) cannot be greater than 160°

38. 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
c) 500 Ω
b) **50 Ω**
d) 0.5 Ω

39. 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

40. In case of an RC half wave triggering circuit, the firing angle can be ideally varied between

a) **0 to 180**
c) 0 to 120
b) 0 to 90
d) 0 to 360

41. In case of a R firing with R2 as the variable resistance, V_{gp} (peak of gate voltage) and V_{gt} (gate triggering voltage) the value of R2 is so adjusted such that

a) $\mathbf{V_{gp} = V_{gt}}$
c) $V_{gp} < V_{gt}$
b) $V_{gp} > V_{gt}$
d) $V_{gp} = V_{gt} = 0$

42. In case of a R firing circuit with $V_{gp} > V_{gt}$

a) $\alpha = 90°$
c) $\boldsymbol{\alpha < 90°}$
b) $\alpha > 90°$
d) $\alpha = 0°$

4. Choppers & Inverters

Position in Question Paper **Total Marks-12**

Q.1. a) 2-Marks.
Q.2. c) 4-Marks.
Q.6. c) 6-Marks.

Descriptive Question

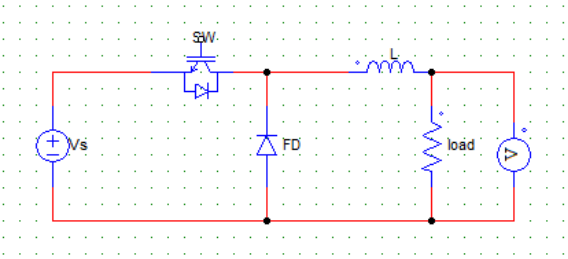
1. List two applications of inverter.
2. Define Chopper. State its types
3. Explain with a neat circuit diagram the operation of parallel inverter.
4. Explain operation of series inverter with neat circuit diagram and waveform.
5. Draw circuit diagram of step up chopper. State its output voltage expression.
6. What is mean by converter? List the types of converter.

MCQ Question

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold.**

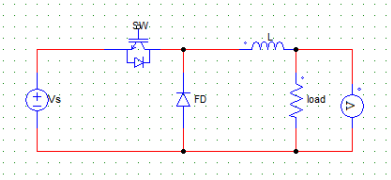
1. In the _____ type of chopper, two stage conversions takes place.
   a) **AC-DC**
   b) AC link
   c) DC link
   d) none of the mentioned
2. Choppers converter
   a) AC to DC
   b) **DC to AC**
   c) DC to DC
   d) AC to AC
3. A chopper may be thought as a
   a) Inverter with DC input
   b) **DC equivalent of an AC transformer**
   c) Diode rectifier
   d) DC equivalent of an induction motor
4. Which device can be used in a chopper circuit?
   a) BJT
   b) MOSFET
   c) GTO
   d) All of the mentioned
5. A chopper is a
   a) Time ratio controller
   b) AC to DC converter
   c) DC transformer
   d) **High speed semiconductor switch**
6. What is the duty cycle of a chopper?
   a) Ton/Toff
   b) **Ton/T**
   c) T/Ton
   d) Toff x Ton
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
8. The values of duty cycle (α) lies between
   a) $0<\alpha<1$
   b) $0>\alpha>-1$
   c) **$0<=\alpha<=1$**
   d) $1<\alpha<100$
9. 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**
10. Find the output voltage expression for a step down chopper with Vs as the input voltage and α as the duty cycle.
    a) $Vo = Vs/\alpha$
    b) **Vo = Vs x α**
    c) $Vo = Vs^2/\alpha$
    d) $Vo = 2Vs/\alpha\pi$
11. The below given figure is that of a _____ (IGBT is used as a chopper switch)



a) step-up/step-down chopper
b) **step-down chopper**
c) step-up chopper
d) none of the mentioned

12. In a step down chopper, if Vs = 100 V and the chopper is operated at a duty cycle of 75 %. Find the output voltage.
a) 100 V
b) **75 V**
c) 25 V
d) none of the mentioned

13. In the below given circuit, when switch (SW) is on



a) **voltage is non-zero and current is rising**
b) voltage is non-zero and current is decaying
c) voltage is zero and current is rising
d) voltage is zero and current is decaying

14. Find the output voltage for a step-up chopper when it is operated at a duty cycle of 50 % and Vs = 240
a) 240 V
b) **480 V**
c) 560 V
d) 120 V

15. If a step up chopper's switch is always kept off then (ideally)
a) Vo = 0
b) Vo = ∞
c) **Vo = Vs**
d) Vo > Vs

16. If a step up chopper's switch is always kept open then (ideally)
a) Vo = 0
b) **Vo =** ∞
c) Vo = Vs
d) Vo > Vs

17. For a step-down chopper, find the rms value of output voltage. Let α be the duty cycle and Vs be the input voltage.
a) α x Vs
b) Vs/α
c) **√α x Vs**
d) Vs/2

18. A step down chopper is operated at 240V at duty cycle of 75%. Find the value of RMS switch (IGBT/MOSFET) current. Take R = 10 **Ω**.
a) **2.07 A**
b) 200 mA
c) 1.58 A
d) 2.4 A

19. 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

20. 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

21. The process of commutating a SCR by applying a reverse voltage to an SCR through a previously charged capacitor is called as
a) Capacitor commutation
b) forced commutation
c) **voltage commutation**
d) current commutation

22. Inverters converts
a) dc power to dc power
b) **dc power to ac power**
c) ac power to ac power
d) ac power to dc power

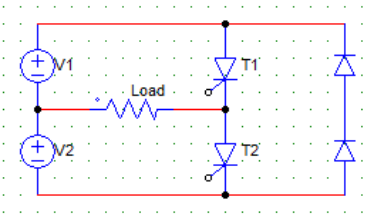
23. Line-commutated inverters have
a) AC on the supply side and DC on the load side
b) **AC on both supply and load side**
c) DC on both supply and load side
d) DC on the supply side and AC on the load side

24. In a VSI (Voltage source inverter)
a) **the internal impedance of the DC source is negligible**
b) the internal impedance of the DC source is very very high
c) the internal impedance of the AC source is negligible
d) the IGBTs are fired at 0 degrees.

25. VSIs using GTOs are turned off by
a) Load commutation
b) line commutation
c) **applying a negative gate pulse**
d) removing the base signal

26. _____ based inverters do not require self-commutation.
a) IGBT
b) GTO
c) PMOSFET
d) SCR

27. Identify the circuit given below.



a) Half wave series inverter
b) Full wave series inverter
c) **Half wave bridge inverter**
d) half wave parallel inverter

28. Single phase half bridge inverters requires
a) Two wire ac supply
b) two wire dc supply
c) three wire ac supply
d) three wire dc supply

29. In a single-phase half wave inverter _____ SCR(s) are/is gated at a time.
a) **One**
b) two
c) three
d) none of the mentioned

30. The voltage in a single phase half wave inverter varies between
    a) Vs and 0
    b) Vs/2 and 0
    c) **/2 and –Vs/2**
    d) Vs and –Vs
31. The output of a single-phase half bridge inverter on R load is ideally
    a) a sine wave
    b) **a square wave**
    c) a triangular wave
    d) constant dc
32. The output current wave of a single-phase full bridge inverter on RL load is
    a) a sine wave
    b) a square wave
    c) **a triangular wave**
    d) constant dc
33. 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
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
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
36. The average output voltage is maximum when SCR is triggered at ωt =
    a) Π
    b) **0**
    c) π/2
    d) π/4
37. In case of TRC (Time Ratio Control), _____ is varied
    a) **Duty cycle**
    b) firing angle
    c) supply frequency
    d) supply voltage magnitude
38. In constant frequency TRC or pulse width modulation scheme, _____ is varied.
    a) Vs
    b) **Ton**
    c) T
    d) f
39. In case of variable frequency system _____ is varied
    a) **T**
    b) Ton
    c) Toff
    d) supply frequency
40. In the current limit control method, the chopper is switched off when
    a) load current reaches the lower limit
    b) **load current reaches the upper limit**
    c) load current falls to zero
    d) none of the mentioned
41. Which of the following mentioned control strategy/strategies would require a feedback loop?
    a) Pwm
    b) constant frequency system
    c) **current limit control**
    d) none of the mentioned

42. In the current limit control method, when the load current reaches a predefined lower value, then
    a) the chopper is switched off
    b) **the chopper is switched on**
    c) the source voltage is removed
    d) load voltage goes to zero

5. Industrial Applications of Power electronics devices

Position in Question Paper **Total Marks-16**

Q.1. g) 2-Marks.
Q.3. a) 4-Marks.
Q.4. c) 4-Marks.
Q.6. a) 6-Marks.

Descriptive Question

1. State the application of SMPS.
2. Draw labeled basic block diagram of UPS
3. Draw the neat circuit diagram of fan speed regulator using Triac. Describe its working.
4. State the function of SMPS. Sketch block diagram of SMPS and label it well.
5. Draw the ON Line & OFF line UPS System.
6. Draw the circuit diagram of light dimmer using DIAC and TRIAC and sketchthe input and output voltage waveforms.
7. Draw labeled circuit diagram of battery charger using SCR
8. Draw circuit diagram and explain the working emergency light system usingSCR.
9. Draw the circuit diagram of temperature controller using SCR with neatCircuit diagram.
10. Draw and explain the diagram of electronic timer using SCR.
11. Draw and explain on-line UPS.

MCQ Question

(Total number of Question=Marks*3=10*3=30)

Note: Correct answer is marked with **bold.**

1. AC voltage controllers convert
   a) Fixed ac to fixed dc
   b) variable ac to variable dc
   c) **fixed ac to variable ac**
   d) variable ac to fixed ac
2. In AC voltage controllers the
   a) variable ac with fixed frequency is obtained
   b) variable ac with variable frequency is obtained
   c) **variable dc with fixed frequency is obtained**
   d) variable dc with variable frequency is obtained
3. Earlier then the semiconductor technology, _____ devices were used for voltage control applications.
   a) Cycloconverter
   b) vacuum tubes
   c) **tap changing transformer**
   d) induction machine
4. The AC voltage controllers are used in _____ applications.
   a) Power generation
   b) **electric heating**
   c) conveyor belt motion
   d) power transmission
5. In the principle of phase control
   a) the load is on for some cycles and off for some cycles
   b) **control is achieved by adjusting the firing angle of the devices**
   c) control is achieved by adjusting the number of on off cycles
   d) control cannot be achieved
6. 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
7. SPMS are based on the _____ principle.
   a) Phase control
   b) Integral control
   c) **Chopper**
   d) MOSFET
8. 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

9. ____ is used for critical loads where temporary power failure can cause a great deal of inconvenience.
   a) SMPS
   b) **UPS**
   c) MPS
   d) RCCB

10. ___ 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

11. Static UPS requires _____
   a) Only rectifier
   b) only inverter
   c) **both inverter and rectifier**
   d) none of the mentioned

12. 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

13. Usually _____ batteries are used in the UPS systems.
   a) NC
   b) Li-On
   c) **Lead acid**
   d) All of the mentioned

14. 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

15. 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

16. 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

17. In HVDC transmission lines
   a) both the stations operate as an inverter
   b) both the stations operate as a converter
   c) **one acts as a converter and other as an inverter**

d) depends upon the type of the load

18. For high power applications _____ are used as static switches whereas for low power applications
    a) **Transistors, SCRs**
    b) SCRs, transistors
    c) Diodes, transistors
    d) SCRs, diodes

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

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

21. 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

22. Solid State Relays (SSRs) have
    a) Moving parts
    b) **no moving parts**
    c) a coil
    d) a contactor

23. Induction heating is a _____ type of heating
    a) Zero frequency
    b) high frequency
    c) **power frequency**
    d) none of the mentioned

24. The factors governing the induction heating are
    a) Resistivity
    b) relative permeability
    c) magnetic field intensity
    d) all of the mentioned

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

26. The ratio Vrms/ Vdc is known as
    a) **Form factor**
    b) ripple factor
    c) Utilization factor
    d) none of the mentioned

27. Determine the loss in the Snubber circuit, if C = 0.545 μF and supply is 200 V, 10 kHz.
    a) 233 W
    b) **133 W**
    c) 333 W
    d) 233 W

28. Ionization in circuit breakers is facilitated by

a) Increase of field strength
b) Increase of mean free path
c) High temperature
d) All of these

29. Usually _____ batteries are used in the UPS systems.
a) NC
b) Li-On
c) **Lead acid**
d) All of the mentioned

30. 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