UNIT – V – APPLICATIONS

1. **What are the applications of power electronics?**
   Variable speed electric drives
   Temperature and illumination controllers
   Power supplies
   HVDC transmission
2. **What are parameters controlled using facts?**
   Series impedance, shunt impedance, current, voltage, phase angle and damping frequencies.
3. **What are the types of facts controllers?**
   Series controllers
   Shunt controllers
   Combined series-series controllers
   Combined series-shunt controllers
4. **What are the types HVDC transmission lines?**
   Monopolar line
   Bipolar line
   Homopolar line
5. **What are the types of ac power supplies in static var system**?
   Switched –mode ac power supplies
   Resonant ac power supplies
   Bidirectional ac power supplies
6. **Define Voltage mode control**.
   The duty cycle is increased to cause a subsequent increase in output voltage in the mode control is called voltage mode control.
7. **Define current mode control.**
   The current mode control uses the current as the feedback signal to achieve output voltage control.
8. **What are the different modes of controlling in drives?**
   Motoring mode
   Reverse motoring mode (Braking mode)
   Generating mode
   Reverse generating mode
9. **What are the types of ac power supplies in static var system?**
   Resonant ac power supplies
   Bidirectional dc power supplies.

10. What are the types of various faults?

Phase failure (PF)
Gate Pulse Failure (GPF)
Turn-on Failure of Thyristor (TFT)
Short Circuit across Thyristor (SCT)
Short Circuit across DC Terminals (SCD)

11. What is meant by SMPS?

SMPS means Switch Mode Power Supply. SMPS is based on the chopper principle. Varying the duty cycle of chopper by PWM techniques controls the output dc voltage.

12. What are the types of SMPS?

Fly back SMPS
Push pull SMPS
Half bridge SMPS
Full bridge SMPS

13. Advantages of SMPS.

For the same power rating,
SMPS is of smaller size,
Lighter in weight and processes,
Higher efficiency,
High frequency operation
Less sensitive to input voltage variations.

14. Disadvantages of SMPS

It has higher output ripple and regulation is worse.
It is a source of both electromagnetic and ratio interference due to high frequency switching
Control of ratio frequency noise requires the use of filters on both input and output.

15. Define thyristor valve.

The term of thyristor valve, used on HVDC systems, denotes a number of thyristors connected in series and parallel to get the required voltage and current ratings.

16. What are the advantages static switches over electromechanical switches.

On time of a static switch (SS) is of the order of 3microseconds, it has therefore very high switching speed.
SS has no moving parts; its maintance is therefore very low.
SS has no bouncing at the time of turning on.
SS has long operational life.

17. Define static circuit breakers.

Static circuit breakers are semi conductor-based circuits capable of providing a fast and reliable interruption to a continuous current.

18. Define resonant converters.

The converter circuits, which employ zero-voltage and or zero current switching, are called resonant converters.

19. What are the types of resonant converters?

Zero Voltage Switching (ZVS)
Zero Current Switching (ZCS)

20. What are the methods of reduction of harmonic content?

Transformer connections
Sinusoidal PWM
Multiple commutation in each cycle
Stepped wave inverters

21. What are the disadvantages of the harmonics present in the inverter system?

Harmonic currents will lead to excessive heating in the induction motors. This will reduce the load carrying capacity of the motor.
If the control and the regulating circuits are not properly shielded, harmonics from power ricuits can affect their operation and malfunctioning can result.
Harmonic current cause losses in the ac system and can even some time produce resonance in the system. Under resonant conditions, the instrumentation and metering can be affected.
On critical loads, torque pulsation produced by the harmonic current can be useful.

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

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

23. Mention some of the applications of controlled rectifier.

Steel rolling mills, printing press, textile mills and paper mills employing dc motor drives.
DC traction
Electro chemical and electro-metallurgical process
Portable hand tool drives
Magnet power supplies
HVDC

24. What is meant by sequence control of ac voltage regulators?

It means that the stages of voltage controllers in parallel triggered in a proper sequence one after the other so as to obtain a variable output with low harmonic content

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25. What are the different methods to turn on the thyristor?

Forward voltage triggering
Gate triggering dv/dt
triggering Temperature
triggering Light
triggering

26. What are the types of UPS?

(i) On line UPS
(ii) Off line UPS
(iii) Line interactive UPS

27. What are the advantages of on line UPS?

(i) It provides isolation between main supply and load
(ii) Since inverter is always on, the quality of load voltage is free from distortion
(iii) Voltage regulation is better
(iv) Transfer time is practically zero since inverter is always on.

28. What are the disadvantages of on line UPS?

(i) Over all efficiency of UPS is reduced
(ii) Cost is high
(iii) The wattage of the rectifier is increased

29. What are the applications of online UPS?

(i) Induction motor drives
(ii) Motor control applications
(iii) Medical equipments

30. What are the application of off line UPS?

(i) Computers
(ii) Printers
(iii) Scanners
(iv) Emergency power supplies

16 MARK QUESTIONS:

1. Draw the circuitry for a static circuit breaker and discuss its advantages and disadvantages.

2. What is the necessity for the UPS? Draw a block diagram for UPS and explain its operation.

3. Discuss the operation of the HVDC system and explain how the power flow can easily be controlled in both the directions. Also elaborate on its merits

4. What is an SMPS? What are its advantages? Draw the circuit arrangement for SMPS and explain briefly its operation.

5. Give a short note on the Monopolar HVDC system.

6. State the advantages of HVDC over conventional ac transmission system. Draw the schematic diagram of dc bipolar transmission system and explain it briefly.

7. What are resonant converters? Give their advantages over PWM controlled converters.

8. Describe M-type ZCS resonant converter with relevant circuits and waveforms. Explain and draw the circuit diagram of shunt and series static var compensators? What are the advantages and disadvantages of static var compensators?

UNIT-5 AC TO AC converters

① Explain the Principle of Integral cycle

→ Single Phase full wave controller ON-OFF control mode.

→ In ON-OFF control method, thyristors are employed as switches to connect the load current to the source for a few cycles of source voltage.

→ In Phase control method, thyristors are employed as switches to connect the load to the ac source for a portion of each cycle of input voltage.

- ON-OFF control circuit diagram
- Explanation
- waveforms of ON-OFF type AC Vtg controller

Advantages

→ The SCRs are switched on at zero crossings.

→ Hence the harmonics due to switching actions are reduced.

Disadvantages:

→ A full supply voltage is applied across the load during ON period, and the load voltage is zero during the OFF period. Hence the load voltage is not smooth rather it intermittent.

→ The load has to sustain huge variations

(2) Explain the operation of Multistage control of AC voltage controllers with neat diagram

→ The Reduction of harmonics and improvement of power factor can be increased, by using more than two stage control.

- circuit diagram of Multistage AC v+g controller
- Explanation

(3) Explain the operation of 1φ AC Voltage controller with RL load.

- Single phase half wave AC voltage controller
- Single Phase full wave AC voltage controller

Half wave AC V+g controller

- circuit Diagram
- Explanation
- waveforms

(4) Explain the 2 stage sequence control of AC voltage controller

→ Sequence control of ac voltage regulators is employed for the reduction of harmonics and the improvement of System Power factor in the input current & voltage.

- Two stage sequence control
  - circuit Diagram
  - Explanation
  - waveforms

→ The triggering pulses of thyristors can be controlled to vary the load voltage. ③

→ The RMS output voltage can be varied with three possible ranges.

1) $0 < V_o < V_1$ 2) $0 < V_o < (V_1 + V_2)$

3) $V_1 < V_o < (V_1 + V_2)$

Case (i) $V_o = V_1 \left[\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)\right]^{1/2}$

Case (ii) $V_o = (V_1 + V_2)\left[\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)\right]^{1/2}$.

⑤ Explain the operation of 1φ to 1φ step down cycloconverter with power circuit and waveforms.

→ It is a 1φ cycloconverter whose input and output are single phase a.c.

↳ Single phase to 1φ step down cycloconverter

- ↳ circuit diagram
- ↳ Explanation
- ↳ waveforms

⑥ 1φ sinusoidal AC voltage controller has input voltage @ 230V, 50Hz and a load of R = 15Ω for 6 cycles ON & 4 cycles OFF determine i) RMS output voltage (ii) input PF (iii) avg & RMS thyristor currents.

Given data: V_s = @ 230V, R = 15Ω, n = 6, m = 4

(14)

Duty cycle $k = \frac{n}{n+m} = \frac{6}{6+4} = 0.6$

RMS output voltage $V_{orms} = V_s\sqrt{k} \Rightarrow 230 \times \sqrt{0.6}$

$V_{orms} = 178.15\,V$

(ii) Input PF $\Rightarrow \sqrt{k} \Rightarrow \sqrt{0.6} = 0.89$ lagging

(iii) Avg. Value of thyristor current $I_{TA} = \frac{kI_m}{\pi}$

$\Rightarrow \frac{0.6 \times 7.56}{\pi} \Rightarrow 9.539\,A$

(iv) RMS value of thyristor current $I_{TR} = \frac{I_m\sqrt{k}}{2}$

$\Rightarrow \frac{7.56 \times \sqrt{0.6}}{2} \Rightarrow 15.435\,A$

(v) Peak thyristor current $I_m = \frac{V_m}{R} = \frac{\sqrt{2} \times 230}{43}$

$I_m = 7.56A$

(7) Describe 3φ to 3φ cycloconverter with relevant circuit arrangement using 18 thyristors

- circuit diagram
- Explanation
- waveforms

(8) write Short notes on matrix converter (5)

→ Matrix Converter is capable of direct conversion from Ac to Ac by using bidirectional fully controlled switches. It is a single stage converter.

- circuit diagram
- Explanation
- Types of control methods
  - Venturini method
  - PWM
  - Space vector modulation

Advantages of matrix converter:

→ Inherent bidirectional Power flow
→ controllable input Power factor independent of the input load current.

Disadvantages

→ control implementation is difficult
→ commutation and protection of the Power switches

(9) with the aid of circuit diagram and waveform explain the operation of Power factor control and Single Phase full wave Ac voltage controller.

↳ The matrix converter uses the matrix of switches so that any of the input Phase voltage can be connected to any of the output load Phase.

(6)

→ Circuit Diagram of full wave AC Voltage
→ Explanation
→ waveform.

(10) A 1φ sinusoidal AC voltage controller has input voltage 230V, 50Hz and its feeding resistive load of 10Ω. If firing angle of thyristor is 110 degree. find i) RMS output voltage ii) input PF iii) avg & RMS thyristor currents

Given data: $V_s = 230V$, $V_m = \sqrt{2} \times 230 = 325.3\ V$

$R = 10\Omega$, $\alpha = 110^\circ$

i) RMS output voltage

$$V_{orms} = V_s \left[\frac{1}{\pi} \left(\pi - \alpha + \frac{\sin 2\alpha}{2} \right) \right]^{1/2}$$

$V_{orms} = 134.08\ V$

(ii) input power factor $= \frac{V_{orms}}{V_s} = 0.582$ (lagg)

(iii) Avg thyristor current $I_{TA} = \frac{V_m}{2\pi R} (1 + \cos\alpha)$

$$I_{TA} = \frac{\sqrt{2} \times 230}{2\pi \times 10} (1 + \cos 110)$$

$I_{TA} = 4.366\ A$

(7)

(11) Explain the operation of 3φ to 1φ cycloconverter with Power circuit and waveforms.

→ waveforms
→ Explanation
→ voltage and current waveform for a three phase cycloconverter
→ Explanation

(12)