

# **SRM VALLIAMMAI ENGINEERING COLLEGE**

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

## **DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

### **QUESTION BANK**



**V SEMESTER**

**EE3562 - POWER ELECTRONICS**

**Regulation – 2023**

**Academic Year 2025 – 2026 ODD**

*Prepared by*

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## QUESTION BANK

**SUBJECT: EE3562- POWER ELECTRONICS**

**SEM / YEAR: V / III**

**Academic Year: 2025 – 2026 ODD**

### **UNIT I - SWITCHING POWER SUPPLIES**

**SYLLABUS:** MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

#### **PART - A**

Q.No	Questions	BT Level	Competence	CO
1	What are the key dynamic characteristics of a MOSFET?	BTL-1	Remembering	CO1
2	Define gate charge and its importance in MOSFET switching.	BTL-2	Understanding	CO1
3	What is the purpose of a gate driver circuit in power electronics?	BTL-2	Understanding	CO1
4	List the advantages of using snubber circuits in switching applications.	BTL-1	Remembering	CO1
5	What is the difference between turn-on and turn-off delay in a	BTL-4	Analyzing	CO1
6	Why are high switching frequencies used in modern power supplies?	BTL-2	Understanding	CO1
7	State the principle of operation of a buck converter.	BTL-1	Remembering	CO1
8	How does a boost converter differ from a buck converter?	BTL-2	Understanding	CO1
9	Define duty cycle in the context of DC-DC converters.	BTL-1	Remembering	CO1
10	What is meant by continuous and discontinuous conduction mode?	BTL-2	Understanding	CO1
11	Why are isolated topologies preferred in some applications?	BTL-2	Understanding	CO1
12	Mention two types of snubber circuits.	BTL-1	Remembering	CO1
13	What is zero-voltage switching (ZVS)?	BTL-1	Remembering	CO1
14	What are the key losses in a switching converter?	BTL-2	Understanding	CO1
15	What is a resonant converter? Give one application.	BTL-2	Understanding	CO1
16	How does a buck-boost converter differ from a buck converter?	BTL-4	Analyzing	CO1
17	Define thermal resistance in power semiconductor devices.	BTL-1	Remembering	CO1
18	What is the significance of a soft-switching technique?	BTL-2	Understanding	CO1
19	List two isolated DC-DC converter topologies.	BTL-1	Remembering	CO1
20	What are the effects of parasitic elements in high-frequency switching?	BTL-4	Analyzing	CO1
21	Define switching loss in MOSFETs.	BTL-1	Remembering	CO1
22	What is the role of heatsinks in thermal management?	BTL-2	Understanding	CO1
23	What is the function of a transformer in isolated DC-DC	BTL-2	Understanding	CO1
24	Name two control strategies used in DC-DC converters.	BTL-1	Remembering	CO1

#### **PART - B**

1	Explain the dynamic behavior of MOSFETs with switching waveform analysis.	BTL-4	Analyzing	CO1
2	Describe the working of gate driver circuits.	BTL-2	Understanding	CO1
3	Design and explain an RC snubber circuit for a power MOSFET.	BTL-6	Creating	CO1

4	Compare and contrast Buck, Boost, and Buck-Boost converters.	BTL-4	Analyzing	CO1
5	Explain the working principle of a Buck converter in CCM and DCM.	BTL-2	Understanding	CO1
6	Design and analyze a Boost converter.	BTL-3	Applying	CO1
7	Describe the operation and design aspects of a Buck-Boost converter.	BTL-3	Applying	CO1
8	Explain isolated DC-DC converter topologies: Push-pull, Half-bridge, and Full-bridge converters.	BTL-2	Understanding	CO1
9	Explain the classification and working principle of resonant converters.	BTL-2	Understanding	CO1
10	Discuss switching loss mechanisms in MOSFETs.	BTL-4	Analyzing	CO1
11	Explain soft-switching techniques in resonant converters.	BTL-4	Analyzing	CO1
12	Design a high-frequency power supply using a Buck converter.	BTL-6	Creating	CO1
13	Discuss the thermal design of power converters.	BTL-5	Evaluating	CO1
14	Simulate and analyze the switching behavior of a MOSFET using MATLAB/PSpice.	BTL-3	Applying	CO1
15	Explain the need and working of isolation in power supplies.	BTL-2	Understanding	CO1
16	Discuss the advantages and challenges of high switching frequency in power supplies.	BTL-5	Evaluating	CO1
17	Compare hard switching and soft switching in terms of efficiency and device stress.	BTL-4	Analyzing	CO1

## UNIT II - INVERTERS

**SYLLABUS:** IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI (1 phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques – various harmonic elimination techniques-CSI, Applications-UPS (Uninterruptible Power Supplies), renewable energy generation systems, Grid Interactive Inverter.

Q.No	Questions	BT	Competence	COs
1	Define the term latching current in IGBT.	BTL-1	Remembering	CO2
2	List two differences between IGBT and MOSFET.	BTL-1	Remembering	CO2
3	What is meant by tail current in IGBT turn-off?	BTL-1	Remembering	CO2
4	Draw the static VI characteristics of IGBT.	BTL-1	Remembering	CO2
5	Mention any two advantages of full-bridge inverter over half-bridge.	BTL-1	Remembering	CO2
6	What is the function of freewheeling diode in a single-phase inverter?	BTL-2	Understanding	CO2
7	Differentiate VSI and CSI based on operation.	BTL-2	Understanding	CO2
8	What is meant by square wave operation in inverters?	BTL-1	Remembering	CO2
9	What is modulation index in PWM inverters?	BTL-2	Understanding	CO2
10	List the advantages of sinusoidal PWM over square wave PWM.	BTL-2	Understanding	CO2
11	Define multi-pulse modulation in inverters.	BTL-1	Remembering	CO2
12	What is the principle of space vector modulation (SVM)?	BTL-2	Understanding	CO2
13	Name any two harmonic elimination techniques in inverters.	BTL-1	Remembering	CO2
14	What is the need for harmonic elimination in inverters?	BTL-2	Understanding	CO2
15	What is the function of CSI in power conversion?	BTL-2	Understanding	CO2
16	Compare CSI and VSI with any two parameters.	BTL-2	Understanding	CO2
17	What is an online UPS system?	BTL-1	Remembering	CO2
18	Why batteries are used in UPS systems?	BTL-2	Understanding	CO2
19	Mention any two types of renewable energy systems using inverters.	BTL-1	Remembering	CO2
20	What is meant by a grid-interactive inverter?	BTL-1	Remembering	CO2
21	List any two grid compliance requirements for grid-connected	BTL-1	Remembering	CO2
22	Define total harmonic distortion (THD).	BTL-1	Remembering	CO2
23	What is the purpose of filters in inverter output?	BTL-2	Understanding	CO2
24	Write any two applications of space vector modulation.	BTL-1	Remembering	CO2
<b>PART – B</b>				
1	Explain the static and dynamic characteristics of IGBT with waveforms.	BTL-4	Analyzing	CO2
2	Compare IGBT with BJT and MOSFET based on switching and conduction characteristics.	BTL-4	Analyzing	CO2
3	With a neat diagram, explain the operation of a single-phase half-bridge inverter.	BTL-2	Understanding	CO2
4	Explain the operation of a single-phase full-bridge inverter with load voltage waveforms.	BTL-2	Understanding	CO2

5	Derive and explain output voltage of three-phase VSI under square wave mode.	BTL-3	Applying	CO2
6	Compare square wave, sinusoidal PWM, and space vector modulation techniques.	BTL-4	Analyzing	CO2
7	Explain in detail single-pulse and multiple-pulse modulation techniques used in voltage control.	BTL-2	Understanding	CO2
8	Describe the working and advantages of sinusoidal PWM.	BTL-2	Understanding	CO2
9	Explain the space vector PWM technique with suitable vector diagram.	BTL-3	Applying	CO2
10	Describe different harmonic elimination techniques used in inverters.	BTL-2	Understanding	CO2
11	Explain the working principle of a Current Source Inverter (CSI).	BTL-2	Understanding	CO2
12	Compare VSI and CSI in terms of performance, control, and applications.	BTL-4	Analyzing	CO2
13	Discuss the design, working, and benefits of online and offline UPS systems.	BTL-4	Analyzing	CO2
14	Explain the role of inverters in renewable energy systems like solar and wind.	BTL-2	Understanding	CO2
15	Write a detailed note on grid-interactive inverters and their control.	BTL-3	Applying	CO2
16	Describe the functions of a smart inverter in grid-tied solar PV systems.	BTL-3	Applying	CO2
17	Explain the need for THD reduction and the use of filters in inverter systems.	BTL-4	Analyzing	CO2

### UNIT III - UNCONTROLLED RECTIFIERS

**SYLLABUS:** Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters– Concern for power quality – three phase Diode Bridge.

#### PART – A

Q.No	Questions	BT Level	Competence	COs
1	Define a power diode.	BTL-1	Remembering	CO3
2	What are the key differences between a power diode and a signal	BTL-1	Remembering	CO3
3	Draw the circuit of a half-wave rectifier using a power diode.	BTL-1	Remembering	CO3
4	Define peak inverse voltage (PIV) in a rectifier.	BTL-1	Remembering	CO3
5	What is the purpose of a center-tapped transformer in a full-wave	BTL-2	Understanding	CO3
6	Mention two advantages of bridge rectifier over center-tap full-	BTL-1	Remembering	CO3
7	Define ripple factor.	BTL-1	Remembering	CO3
8	What is a voltage doubler circuit?	BTL-1	Remembering	CO3
9	Differentiate between full-wave rectifier and voltage doubler.	BTL-2	Understanding	CO3
10	What is distortion factor in power conversion systems?	BTL-2	Understanding	CO3
11	Define the term form factor in rectifiers.	BTL-1	Remembering	CO3
12	What is the function of a capacitor in a rectifier circuit?	BTL-2	Understanding	CO3
13	Why is capacitor filtering more suitable for low-power applications?	BTL-2	Understanding	CO3
14	What is an LC filter?	BTL-1	Remembering	CO3
15	Compare capacitor filter and LC filter.	BTL-2	Understanding	CO3
16	What is the effect of filters on output voltage ripple?	BTL-2	Understanding	CO3
17	What are the sources of harmonics in rectifier circuits?	BTL-2	Understanding	CO3
18	List any two power quality concerns due to rectifiers.	BTL-1	Remembering	CO3
19	What is input current distortion in rectifiers?	BTL-2	Understanding	CO3
20	Write the circuit symbol of a three-phase diode.	BTL-1	Remembering	CO3
21	What is the number of pulses in a three-phase diode bridge rectifier?	BTL-1	Remembering	CO3
22	Mention two advantages of three-phase rectifier over single-	BTL-1	Remembering	CO3
23	What is the typical output waveform of a three-phase diode	BTL-2	Understanding	CO3
24	How does power factor vary in rectifiers with and without filters?	BTL-2	Understanding	CO3

#### PART – B

1	Explain the construction and VI characteristics of a power diode.	BTL-2	Understanding	CO3
2	Describe the operation of a single-phase half-wave rectifier with waveform and output voltage.	BTL-2	Understanding	CO3
3	Explain the working of full-wave rectifier using center-tap transformer.	BTL-2	Understanding	CO3
4	Draw and explain the operation of a bridge rectifier.	BTL-2	Understanding	CO3
5	Compare half-wave, full-wave, and bridge rectifiers in terms of efficiency and ripple.	BTL-4	Analyzing	CO3
6	Explain the operation of voltage doubler circuits with neat diagrams.	BTL-2	Understanding	CO3
7	Derive expressions for output voltage and ripple factor for capacitor filter with full-wave rectifier.	BTL-3	Applying	CO3

8	Discuss the working and advantages of LC filters used in power rectifiers.	BTL-2	Understanding	CO3
9	Analyze the output waveform and filtering performance of LC filters.	BTL-4	Analyzing	CO3
10	Explain distortion factor and how it impacts power quality in rectifier systems.	BTL-4	Analyzing	CO3
11	Discuss various sources of harmonics in rectifiers and techniques for their mitigation.	BTL-4	Analyzing	CO3
12	Explain the need for power quality improvement in rectifier-based systems.	BTL-3	Applying	CO3
13	Describe the operation of a three-phase diode bridge rectifier and derive output voltage.	BTL-3	Applying	CO3
14	Compare single-phase and three-phase diode bridge rectifiers.	BTL-4	Analyzing	CO3
15	Analyze the effect of capacitor and LC filter on voltage ripple and THD.	BTL-4	Analyzing	CO3
16	Explain power factor correction techniques used in rectifier systems.	BTL-4	Analyzing	CO3
17	Design a filter circuit for a single-phase bridge rectifier with given ripple specification.	BTL-6	Creating	CO3

## UNIT IV-CONTROLLED RECTIFIERS

**SYLLABUS:** SCR-Two transistor analogy-based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit, Applications- power regulators and motor control.

### PART – A

Q.No	Questions	BT Level	Competence	COs
1	What is an SCR and its basic structure?	BTL-1	Remembering	CO4
2	Draw and explain the two-transistor model of an SCR.	BTL-2	Understanding	CO4
3	Define latching current and holding current in SCR.	BTL-1	Remembering	CO4
4	What is the significance of gate current in SCR turn-on?	BTL-2	Understanding	CO4
5	What are turn-on losses in SCR?	BTL-1	Remembering	CO4
6	Why is thermal protection necessary for SCRs?	BTL-2	Understanding	CO4
7	List any two methods of thermal protection for power devices.	BTL-1	Remembering	CO4
8	What is a controlled converter?	BTL-1	Remembering	CO4
9	Differentiate between 1-pulse and 2-pulse controlled converters.	BTL-2	Understanding	CO4
10	What is a 6-pulse controlled converter?	BTL-1	Remembering	CO4
11	Define displacement factor in converter circuits.	BTL-1	Remembering	CO4
12	What is the ripple factor?	BTL-1	Remembering	CO4
13	What are harmonics and how do they arise in SCR converters?	BTL-2	Understanding	CO4
14	Define power factor in controlled rectifiers.	BTL-1	Remembering	CO4
15	What is the effect of source inductance in SCR converters?	BTL-2	Understanding	CO4
16	What do you mean by inverter angle limit in a converter?	BTL-2	Understanding	CO4
17	What is commutation overlap?	BTL-2	Understanding	CO4
18	List any two techniques for power factor mitigation in	BTL-1	Remembering	CO4
19	What are the performance parameters of an SCR converter?	BTL-2	Understanding	CO4
20	Define the term input power factor in the context of SCR	BTL-1	Remembering	CO4
21	What are the advantages of using controlled rectifiers?	BTL-2	Understanding	CO4
22	What is the application of SCRs in power regulation?	BTL-1	Remembering	CO4
23	How is an SCR used in DC motor speed control?	BTL-2	Understanding	CO4
24	Mention one industrial application each of single-phase and	BTL-1	Remembering	CO4

### PART – B

1	Explain the two-transistor analogy of SCR and how it helps to understand SCR turn-on.	BTL-2	Understanding	CO4
2	Explain turn-on and turn-off characteristics of an SCR with waveforms.	BTL-2	Understanding	CO4
3	Discuss different types of losses in SCR and methods for thermal protection.	BTL-4	Analyzing	CO4
4	Describe the operation of a single-phase 1-pulse controlled converter with relevant waveforms.	BTL-2	Understanding	CO4
5	With neat waveforms, explain the working of a two-pulse mid-point SCR converter.	BTL-2	Understanding	CO4
6	Derive expressions for average and RMS output voltage of a 3-pulse converter.	BTL-3	Applying	CO4
7	Explain the operation of a 6-pulse bridge controlled rectifier.	BTL-3	Applying	CO4

8	Compare 1-pulse, 2-pulse, 3-pulse, and 6-pulse converters in terms of output voltage, ripple.	BTL-4	Analyzing	CO4
9	Define and derive expressions for displacement factor, ripple factor, and harmonic factor.	BTL-3	Applying	CO4
10	Explain the impact of harmonics and power factor in SCR converters.	BTL-4	Analyzing	CO4
11	Describe the effect of source inductance on the performance of controlled converters.	BTL-4	Analyzing	CO4
12	Discuss inverter angle limits and their significance in converter performance.	BTL-3	Applying	CO4
13	Explain the methods to mitigate low power factor in SCR converters.	BTL-4	Analyzing	CO4
14	List and explain key performance parameters of SCR-based converters.	BTL-2	Understanding	CO4
15	Explain the working of an SCR-based power regulator with circuit and waveform.	BTL-3	Applying	CO4
16	Describe the speed control of DC motor using single-phase SCR converter.	BTL-3	Applying	CO4
17	Compare controlled and uncontrolled rectifiers based on performance and applications.	BTL-4	Analyzing	CO4

**UNIT V - AC PHASE CONTROLLERS**

**SYLLABUS:** TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers, single phase and three phase cyclo converters, Applications –welding.

**PART – A**

Q.No	Questions	BT Level	Competence	C
1	What is a TRIAC?	BTL-1	Remembering	CO5
2	Draw the symbol of a TRIAC and mention its terminals.	BTL-1	Remembering	CO5
3	How does a TRIAC differ from an SCR?	BTL-2	Understanding	CO5
4	Define the term "quadrant operation" in TRIAC triggering.	BTL-1	Remembering	CO5
5	What is the function of a gate pulse in TRIAC triggering?	BTL-2	Understanding	CO5
6	List the four triggering modes of TRIAC.	BTL-1	Remembering	CO5
7	Differentiate between positive and negative gate triggering of TRIAC.	BTL-2	Understanding	CO5
8	What is a TRIAC-based phase controller?	BTL-1	Remembering	CO5
9	Define firing angle and its role in phase control.	BTL-1	Remembering	CO5
10	Mention one application of a TRIAC in domestic appliances.	BTL-1	Remembering	CO5
11	What is the function of DIAC in TRIAC triggering circuits?	BTL-2	Understanding	CO5
12	What are the basic configurations of SCR-based single-phase AC controllers?	BTL-1	Remembering	CO5
13	List two SCR-based three-phase controller types.	BTL-1	Remembering	CO5
14	What is the function of an AC voltage controller?	BTL-2	Understanding	CO5
15	What is a cycloconverter?	BTL-1	Remembering	CO5
16	State one application each of single-phase and three-phase cycloconverters.	BTL-1	Remembering	CO5
17	What is step-down cycloconversion?	BTL-2	Understanding	CO5
18	Define frequency modulation in cycloconverters.	BTL-1	Remembering	CO5
19	What is meant by phase control in AC to AC conversion?	BTL-2	Understanding	CO5
20	What are the major harmonics introduced by cycloconverters?	BTL-2	Understanding	CO5
21	Why are cycloconverters preferred for low-frequency applications?	BTL-2	Understanding	CO5
22	List any two industrial applications of TRIAC-based controllers.	BTL-1	Remembering	CO5
23	How is a cycloconverter used in welding applications?	BTL-2	Understanding	CO5
24	What is the effect of firing angle on output voltage in phase control?	BTL-2	Understanding	CO5

**PART – B**

1	Explain TRIAC triggering in all four quadrants with waveform diagrams.	BTL-2	Understanding	CO5
2	Describe the operation of TRIAC with positive and negative gate pulse triggering.	BTL-2	Understanding	CO5
3	Draw and explain a TRIAC-based phase controller circuit.	BTL-2	Understanding	CO5

4	With neat diagrams, explain the working of DIAC-TRIAC triggering circuits.	BTL-3	Applying	CO5
5	Discuss the various configurations of SCR-based single-phase AC voltage controllers.	BTL-4	Analyzing	CO5
6	Compare half-controlled and full-controlled single-phase AC controllers using SCRs.	BTL-4	Analyzing	CO5
7	Explain the working of a three-phase SCR-based AC voltage controller.	BTL-3	Applying	CO5
8	Describe the types of single-phase cycloconverters with output waveforms.	BTL-2	Understanding	CO5
9	Explain the principle of operation of a three-phase to single-phase cycloconverter.	BTL-3	Applying	CO5
10	Describe the frequency step-down operation of a cycloconverter with suitable circuit.	BTL-2	Understanding	CO5
11	Compare cycloconverter and inverter based on frequency conversion and harmonics.	BTL-4	Analyzing	CO5
12	Explain how firing angle control affects output in a TRIAC phase controller.	BTL-3	Applying	CO5
13	Discuss the effect of load type (resistive, inductive) on TRIAC triggering and output.	BTL-4	Analyzing	CO5
14	Explain the role of AC voltage regulators in welding applications.	BTL-3	Applying	CO5
15	With a block diagram, explain how cycloconverters are used in electric arc welding.	BTL-2	Understanding	CO5
16	List and explain the major performance factors to be considered in AC voltage controllers.	BTL-4	Analyzing	CO5
17	Analyze the harmonic content and power quality impact of cycloconverter-fed systems.	BTL-4	Analyzing	CO5

### **Course Outcomes:**

<b>Cos</b>	<b>Course Outcome</b>
CO1	Analyze the operation and dynamic characteristics of power semiconductor devices, and design and simulate low-power Switch Mode Power Supplies (SMPS).
CO2	Analyze various uncontrolled rectifier configurations and design appropriate filter circuits for specified applications.
CO3	Evaluate the performance of n-pulse converter circuits by analyzing their operation and computing key performance parameters (THD, efficiency, ripple)
CO4	Apply various Pulse Width Modulation (PWM) techniques to inverter circuits and analyze voltage control and harmonic elimination strategies.
CO5	Analyze the operation of AC voltage controllers and evaluate their applications in industrial and domestic settings.