GUJARAT TECHNOLOGICAL UNIVERSITY

BE 7 SEMESTER – OLD PAPER – SUMMER 2022 TO SUMMER 2026 – QUESTION BANK

Subject Name & Code: Advanced Power Electronics - 3170906

Chapter 1: Switching Voltage Regulators

Repeated Questions:

1. SMPS Basics and Regulator Comparison (Theory):

- **Q.** Compare Linear voltage regulator and Switch mode voltage regulator with the help of block diagram. [Diagram required – refer to the original question paper] **(WINTER 2022; WINTER 2023; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

2. Flyback Converter:

- **Q.** Explain fly back converter. **(SUMMER 2023, 4 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 4 Marks)**
- **Q.** Explain fly back converter topology with diagram and wave forms. [Diagram required – refer to the original question paper] **(WINTER 2024, 3 Marks)**
- **Q.** Giving circuit diagram and showing waveforms, explain working of fly-back converter type switched mode DC power supply. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks)**
- **Q.** Discuss operation of Flyback converter. Draw its circuit diagram and waveforms. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks)**

3. Cuk and SEPIC Converters:

- **Q.** Describe Cuk converter with circuit diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Discuss operation of CUK converter. Derive the relation between duty ratio and i/p voltage. **(SUMMER 2023, 7 Marks)**
- **Q.** Describe Cuk converter with circuit diagram and necessary waveform. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

4. Buck, Boost and Buck-Boost Converters:

- **Q.** Derive output equation for the buck-boost converter with necessary circuit diagram and waveform. [Diagram required – refer to the original question paper] **(WINTER 2022)**
- **Q.** Derive output equation for the buck-boost converter with necessary waveform. **(SUMMER 2024, 7 Marks OR)**
- **Q.** Derive the expression for duty ratio in continuous and discontinuous mode of operation for Buck-Boost converter with circuit diagram and waveform. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**

5. Continuous and Discontinuous Conduction Mode:

- **Q.** Differentiate between continuous mode of conduction and discontinuous mode of conduction. **(WINTER 2022 OR; SUMMER 2024, 3 Marks OR; SUMMER 2025, 3 Marks)**
- **Q.** Give comparison between continuous conduction mode and discontinuous conduction mode. **(SUMMER 2022)**

6. Push-Pull, Forward, Half-Bridge, Full-Bridge and Multi-Output Converters:

- **Q.** Illustrate the push pull converter with neat circuit diagram & waveform. [Diagram required – refer to the original question paper] **(SUMMER 2026, 4 Marks)**

- **Q.** Illustrate the push pull converter with neat circuit diagram & waveform and derive the equation of output voltage in terms of input voltage & duty cycle. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks)**
- **Q.** Discuss operation of Push pull converter type switched mode dc power supply along with necessary waveforms. **(WINTER 2024, 7 Marks OR)**

Other Important Questions:

1. Push-Pull, Forward, Half-Bridge, Full-Bridge and Multi-Output Converters:

- **Q.** Explain full bridge converter. State its advantages over half bridge converter. **(WINTER 2022)**
- **Q.** Explain half bridge converter. **(WINTER 2025, 3 Marks OR)**
- **Q.** Draw only the circuit diagram of flyback, forward and full bridge converter. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Discuss multi output switch mode regulators. **(SUMMER 2022, 3 Marks)**
- **Q.** Explain Multi output switch mode regulator with help of circuit diagram. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Explain the operation of two transistor forward converter with circuit diagram, waveform and required equation. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks OR)**

2. SMPS Basics and Regulator Comparison (Theory):

- **Q.** State important advantages, disadvantages and application of SMPS. **(SUMMER 2023, 3 Marks)**
- **Q.** State important advantages, disadvantages and applications of SMPS. Draw the circuit diagram and waveform of five levels cascaded H-Bridge Multilevel Inverter and explain its working. OR [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks - question text as printed combines SMPS and multilevel inverter topics (likely typographical error in source paper))**
- **Q.** Figure out the specifications/properties of a good power supply. **(WINTER 2023, 7 Marks)**
- **Q.** Define duty cycle and write its importance. **(SUMMER 2025, 3 Marks)**
- **Q.** What is the difference between isolated and non-isolated dc power supply? **(WINTER 2024, 3 Marks OR)**

3. Cuk and SEPIC Converters:

- **Q.** Describe SEPIC converter with circuit diagram. [Diagram required – refer to the original question paper] **(SUMMER 2024, 3 Marks)**

4. Buck, Boost and Buck-Boost Converters:

- **Q.** Compare buck, boost and buck-boost converter with reference to technical parameters. **(SUMMER 2024, 4 Marks)**
- **Q.** Draw necessary waveforms and explain working of Boost converter in continuous and discontinuous conduction mode. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Discuss operation of Buck converter in continuous and discontinuous conduction mode. **(WINTER 2023)**
- **Q.** Discuss discontinuous mode of operation in buck boost converter with waveforms. **(SUMMER 2022, 7 Marks)**

Chapter 2: Resonant Converters

Repeated Questions:

1. Classification and Need of Resonant Converters (Theory):

- **Q.** Classify the Resonant converter. **(SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks)**
- **Q.** What is the need of Resonant Converter? Compare Series Loaded Resonant (SLR) converter with Parallel Loaded Resonant (PLR) converter. **(SUMMER 2022, 4 Marks; WINTER 2022 OR; SUMMER 2023, 4 Marks; WINTER 2024, 4 Marks; SUMMER 2025)**
- **Q.** What is the need of Resonant Converter? Give classification of resonant converter. **(SUMMER 2026, 3 Marks)**
- **Q.** Give Classification of resonant converters. **(SUMMER 2025, 3 Marks)**
- **Q.** Classify resonant pulse converter and discuss applications. **(WINTER 2023; SUMMER 2024, 3 Marks)**
- **Q.** Write the advantages of resonance converter as compared to PWM converter. **(WINTER 2023 OR; SUMMER 2024, 4 Marks)**

2. ZVS and ZCS – Comparison (Theory):

- **Q.** Compare ZVS-ZCS converter. **(WINTER 2025, 4 Marks)**
- **Q.** Give comparison between Zero Voltage Switching and Zero Current Switching resonant converters. **(SUMMER 2024, 4 Marks)**
- **Q.** Compare ZCS and ZVS. **(WINTER 2023; SUMMER 2026, 4 Marks OR)**
- **Q.** Give comparison of ZCS & ZVS resonant converter. **(WINTER 2022, 3 Marks OR)**

3. ZVS Converter – Operation:

- **Q.** Explain operation of ZVS converter with diagram and wave forms. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Explain the operation of Zero Voltage Switching resonant converter with circuit diagram, waveform and required equation. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks)**
- **Q.** What do you mean by Zero Voltage Switching (ZVS). With neat circuit and waveform explain the operation of ZVS Converter. [Diagram required – refer to the original question paper] **(SUMMER 2025)**

4. ZCS, Parallel Loaded and Class E Resonant Converters:

- **Q.** Explain the operation of Class E converter. **(WINTER 2022, 4 Marks; SUMMER 2024, 4 Marks OR)**

Other Important Questions:

1. Classification and Need of Resonant Converters (Theory):

- **Q.** Explain the working principle of resonant converter. **(WINTER 2022, 3 Marks)**

2. ZCS, Parallel Loaded and Class E Resonant Converters:

- **Q.** Discuss operation of parallel load resonant DC to DC converter. **(SUMMER 2024, 7 Marks)**
- **Q.** Draw only circuit diagram of Zero current switching DC-DC converter and Clamped Voltage topology. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** With neat circuit diagram and waveform discuss class E resonant inverter. [Diagram required – refer to the original question paper] **(WINTER 2023)**
- **Q.** Explain zero current switching dc-dc converter. **(SUMMER 2022, 7 Marks OR)**

3. ZVS Converter – Operation:

- **Q.** Justify the name of converter as zero voltage switching converter with necessary diagram and waveform. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Draw circuit diagram and waveforms of Zero Voltage Switching Converter. [Diagram required – refer to the original question paper] **(WINTER 2023 OR)**

Chapter 3: Multi-level converters

Repeated Questions:

1. Concept and Need of Multilevel Inverter (Theory):

- **Q.** Explain concept of multilevel inverter. **(WINTER 2025, 3 Marks)**
- **Q.** Explain the concept and need of Multi Level inverter. **(SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks)**
- **Q.** Explain the concept & need of Multi Level Inverter (MLI). **(SUMMER 2022, 3 Marks)**

2. Multilevel Inverter Topologies – Comparison:

- **Q.** Compare the three topologies of multilevel inverter. **(SUMMER 2023, 4 Marks OR; WINTER 2024, 4 Marks; SUMMER 2025, 3 Marks OR; WINTER 2025, 4 Marks OR)**

3. Cascaded H-Bridge Multilevel Inverter:

- **Q.** What are the advantages of cascaded H bridge multi-level inverter over other two topologies? **(SUMMER 2022; SUMMER 2025, 4 Marks OR)**
- **Q.** Explain operation of Cascaded H-bridge multilevel inverter. **(SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks OR)**
- **Q.** Explain the operation of Cascaded H-bridge multilevel inverter. **(SUMMER 2023, 7 Marks OR)**
- **Q.** Draw the circuit diagram of 5 level cascaded H-bridge multi-level inverter and explain the operation with switching table. [Diagram required – refer to the original question paper] **(SUMMER 2026 OR)**
- **Q.** Draw the circuit diagram and waveform of five levels cascaded H-Bridge Multilevel Inverter and explain its working. [Diagram required – refer to the original question paper] **(WINTER 2022; WINTER 2025, 7 Marks)**

4. Diode Clamped Multilevel Inverter:

- **Q.** Draw circuit diagram and wave forms of five level diode clamped inverter. Explain its working. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks)**
- **Q.** Explain the working of one leg five levels diode clamped multilevel inverter with circuit diagram and waveform. Also mention its salient features. [Diagram required – refer to the original question paper] **(WINTER 2022 OR)**
- **Q.** Draw circuit diagram and waveforms of five level diode clamped inverter. [Diagram required – refer to the original question paper] **(WINTER 2023)**
- **Q.** Draw the circuit diagram of 5 level diode clamped multi level inverter and explain the operation with switching table. [Diagram required – refer to the original question paper] **(SUMMER 2026)**

5. PWM Techniques for Multilevel Inverter:

- **Q.** Classify carrier based PWM technique for multilevel inverter. Discuss any one in brief. **(SUMMER 2026)**
- **Q.** Classify carrier based PWM technique for multilevel inverter. Discuss any one in detail. **(SUMMER 2025, 4 Marks)**
- **Q.** Discuss sine PWM techniques used for multilevel inverter. **(SUMMER 2022, 7 Marks OR; WINTER 2024, 7 Marks)**

6. Multilevel versus Multipulse Converters:

- **Q.** Explain difference between multi pulse converter and multilevel converter with suitable diagram. [Diagram required – refer to the original question paper] **(SUMMER 2023, 4 Marks; WINTER 2023 OR; WINTER 2023)**

Other Important Questions:

1. Diode Clamped Multilevel Inverter:

- **Q.** Explain working of Diode Clamped three level inverter. **(WINTER 2025, 7 Marks OR)**
- **Q.** Explain operation of diode clamped multilevel inverter. **(SUMMER 2024, 4 Marks OR)**

2. Concept and Need of Multilevel Inverter (Theory):

- **Q.** Explain the limitations of Multilevel inverter. **(SUMMER 2024, 3 Marks)**

3. PWM Techniques for Multilevel Inverter:

- **Q.** Justify the sentence, "Space vector pulse width modulation technique is better than sine PWM technique". **(SUMMER 2024, 7 Marks)**

4. Flying Capacitor Multilevel Inverter:

- **Q.** Draw circuit diagram and waveforms of five level flying capacitor inverter. Explain its working. [Diagram required – refer to the original question paper] **(WINTER 2023)**

5. Cascaded H-Bridge Multilevel Inverter:

- **Q.** Mention advantages of H bridge multilevel inverter. Explain working of five level H bridge inverter. **(WINTER 2023 OR)**

Chapter 4: Multipulse Converters

Repeated Questions:

1. Transformer Connections for Multipulse Converters:

- **Q.** Draw the transformer connections for 18 pulse converter. Explain Y-Z2 transformer connection used for multipulse converter. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks OR; WINTER 2025, 7 Marks)**
- **Q.** Explain Y-Z2 transformer connection used for multipulse converter. **(WINTER 2023 OR)**
- **Q.** Explain following transformer connection with phasor diagram used in multi pulse converter. (a) Y-Z1 (b) Δ-Z1. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; WINTER 2022; SUMMER 2025, 7 Marks OR)**

2. Phase Shifting Transformer:

- **Q.** Give classification and applications of phase shifting transformer. **(SUMMER 2025, 3 Marks OR; SUMMER 2026, 4 Marks)**
- **Q.** Discuss need of phase shifting transformer. **(SUMMER 2022, 4 Marks; WINTER 2024, 3 Marks OR)**

3. Multipulse Converter – Concept, Advantages and Disadvantages:

- **Q.** Explain concept of multi pulse converter. State advantages and disadvantages of multi-pulse converters. **(SUMMER 2024 OR; SUMMER 2026)**
- **Q.** State advantages and disadvantages of multi-pulse converters. **(SUMMER 2023, 3 Marks OR; WINTER 2023; WINTER 2024, 4 Marks OR)**

4. 12-Pulse Converter, Harmonics and Six-Pulse Rectifier:

- **Q.** Draw schematic diagram of 12 pulse converter with transformer connection. [Diagram required – refer to the original question paper] **(SUMMER 2022, 3 Marks OR)**
- **Q.** Draw circuit diagram and output voltage phasor diagram of 12-pulse converter. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks)**

Other Important Questions:

1. Phase Shifting Transformer:

- **Q.** Explain star/delta phase shifting transformer with phasor diagram. [Diagram required – refer to the original question paper] **(SUMMER 2025, 3 Marks)**

2. Multipulse Converter – Concept, Advantages and Disadvantages:

- **Q.** Why multi pulse converter is better than conventional converter? **(WINTER 2022, 3 Marks)**

3. 12-Pulse Converter, Harmonics and Six-Pulse Rectifier:

- **Q.** How the harmonic current are canceled by phase shifting transformer in 12 pulse rectifier? Explain with necessary schematic diagram. [Diagram required – refer to the original question paper] **(WINTER 2022)**
- **Q.** Which harmonics are dominant in line for a 12-pulse multi-pulse converter? Also, explain how harmonic cancellation occurs in multi-pulse converter. **(SUMMER 2026 OR)**
- **Q.** Explain the operation of six pulse diode rectifier with resistive load with necessary diagram and waveform. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks OR)**

Chapter 5: HVDC Transmission

Repeated Questions:

1. HVAC versus HVDC Transmission (Theory):

- **Q.** Give Comparison of HVAC and HVDC transmission. **(SUMMER 2022, 4 Marks OR; SUMMER 2023, 4 Marks; WINTER 2025, 4 Marks)**
- **Q.** Compare HVDC transmission over HVAC transmission based on Economics of Transmission, Technical Performance & Reliability. **(SUMMER 2026, 4 Marks)**
- **Q.** Compare HVDC and HVAC transmission systems. **(WINTER 2022, 3 Marks; WINTER 2023 OR; SUMMER 2024, 7 Marks OR)**

2. Equipment Required for HVDC System:

- **Q.** Discuss Equipment required for HVDC System and their significance. **(WINTER 2025, 3 Marks)**
- **Q.** Explain the all equipments required for HVDC system. **(WINTER 2025, 4 Marks OR)**
- **Q.** Draw block diagram of HVDC transmission system. Discuss equipment required for HVDC system and give their significance. [Diagram required – refer to the original question paper] **(SUMMER 2026)**
- **Q.** Discuss the equipment required for HVDC systems. **(WINTER 2022, 7 Marks OR)**
- **Q.** Draw the typical HVDC transmission scheme and explain the equipments required for HVDC system. **(SUMMER 2023, 4 Marks OR; WINTER 2024, 4 Marks)**
- **Q.** Draw block diagram of HVDC transmission system. Mention equipment required for HVDC system. [Diagram required – refer to the original question paper] **(SUMMER 2025, 4 Marks OR)**

3. Types of HVDC Links and 12-Pulse Converters:

- **Q.** Draw schematic diagram of Monopolar, Bipolar and Homopolar link. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks; WINTER 2023)**
- **Q.** Explain different type of HVDC link. **(SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks OR)**
- **Q.** Explain different types of HVDC link. **(SUMMER 2025, 3 Marks OR)**
- **Q.** Draw and explain bipolar HVDC power transmission system based on 12 pulse converters for each pole. **(SUMMER 2023, 7 Marks; WINTER 2025, 7 Marks OR)**

Other Important Questions:

1. HVDC Control and Advantages:

- **Q.** Discuss control of HVDC system. **(SUMMER 2026, 3 Marks OR)**
- **Q.** State the advantages HVDC transmission over EHVAC for bulk power transmission. **(WINTER 2024, 7 Marks OR)**

2. Types of HVDC Links and 12-Pulse Converters:

- **Q.** Draw the circuit diagram and waveform of 12 pulse converter and explain its working principle. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**
- **Q.** State the types of HVDC systems and explain each in brief. **(WINTER 2023)**

Chapter 6: FACTS devices

Repeated Questions:

1. Definition, Classification and Benefits of FACTS (Theory):

- **Q.** Define FACTS. Give detail classification of FACTS controller. **(SUMMER 2023, 4 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Define FACTS. Give classification of FACTS controllers. **(WINTER 2024, 4 Marks)**
- **Q.** Classification Of FACTS devices. **(SUMMER 2022, 3 Marks)**
- **Q.** Define Flexible ac Transmission Systems (FACTS) with brief description. **(WINTER 2022 OR)**
- **Q.** Define FACTS systems and state its possible benefits in Emerging Transmission Network. **(WINTER 2023, 3 Marks OR)**
- **Q.** Define FACTS. State the advantages of FACTS devices. **(SUMMER 2026 OR)**
- **Q.** State the advantages of FACTS devices. **(SUMMER 2024, 3 Marks OR)**

2. SVC and STATCOM:

- **Q.** Give comparison of SVC and STATCOM. **(SUMMER 2022, 4 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks; SUMMER 2026 OR)**
- **Q.** Compare SVC and STATCOM. **(SUMMER 2023, 3 Marks OR)**
- **Q.** Discuss static characteristics of STATCOM. **(WINTER 2022, 3 Marks; SUMMER 2025, 4 Marks OR)**
- **Q.** Explain working of STATCOM with neat diagram. Also explain its static characteristic. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks OR)**

3. Unified Power Flow Controller (UPFC):

- **Q.** Explain operating principle of Unified Power Flow Controller (UPFC). **(SUMMER 2022, 7 Marks OR; WINTER 2022 OR; SUMMER 2023, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 3 Marks)**
- **Q.** Explain working principle of UPFC. **(SUMMER 2026 OR)**

4. TCR, FC-TCR and TSC-TCR:

- **Q.** Explain the working principle of Thyristorised controlled Reactor (TCR) with neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2023)**
- **Q.** Explain TCR with circuit diagram. Draw current and voltage waveforms for different values of α. [Diagram required – refer to the original question paper] **(SUMMER 2025; SUMMER 2026)**
- **Q.** Explain the working of fixed capacitor thyristor-controlled reactor. **(SUMMER 2024, 4 Marks)**
- **Q.** Explain the working of Fixed Capacitor Thyristor-Controlled Reactor (FC-TCR). Draw neat diagrams. [Diagram required – refer to the original question paper] **(WINTER 2024, 4 Marks OR)**
- **Q.** Discuss principle of shunt compensation. Explain operation of fixed capacitor-thyristor controlled reactor. **(WINTER 2023; WINTER 2025, 7 Marks OR)**
- **Q.** Explain the working principle of TSC-TCR. **(WINTER 2022, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks OR)**

5. SSSC and Series Compensation:

- **Q.** Explain working principle of SSSC. **(SUMMER 2022, 3 Marks; SUMMER 2024, 4 Marks OR; WINTER 2024, 3 Marks)**
- **Q.** Explain the working of Static Synchronous Series Compensator (SSSC) with neat diagrams. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks OR)**
- **Q.** State advantages and limitation of SSSC. **(SUMMER 2022, 4 Marks OR; WINTER 2022, 4 Marks)**

- **Q.** Explain the advantages and limitations of static synchronous series compensator (SSSC). **(SUMMER 2023, 3 Marks)**
- **Q.** Discuss principle of series compensation. Explain operation of static synchronous series compensator (SSSC). **(WINTER 2025, 7 Marks)**
- **Q.** Discuss the principle of series compensation. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain principle of series compensation. Discuss static synchronous series compensator. **(SUMMER 2026)**
- **Q.** Discuss the principle of series compensation and state various methods for series compensation. **(SUMMER 2025)**

6. Reactive Power and Phase Angle Compensation (Theory):

- **Q.** State the need of reactive power compensation. **(WINTER 2023 OR; SUMMER 2025, 3 Marks)**
- **Q.** Explain the need of reactive power compensation. **(SUMMER 2026, 3 Marks)**
- **Q.** Discuss importance of reactive power compensation. Discuss phase-shifting transformer with necessary diagram in brief. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks OR)**
- **Q.** What is phase angle compensation in transmission line? **(SUMMER 2023, 3 Marks OR; WINTER 2024, 4 Marks OR; WINTER 2025, 3 Marks OR)**
- **Q.** What is phase angle compensation in transmission system? **(SUMMER 2025, 4 Marks)**

Other Important Questions:

1. SVC and STATCOM:

- **Q.** Discuss static characteristics of SVC. **(WINTER 2022, 4 Marks)**
- **Q.** What is Synchronous Condenser? **(SUMMER 2023, 4 Marks OR)**

2. TCR, FC-TCR and TSC-TCR:

- **Q.** Explain the delta connected 3 phase-TCR with necessary diagram and waveforms. [Diagram required – refer to the original question paper] **(WINTER 2023 OR)**
- **Q.** Explain the working of three-phase Thyristor Controlled Reactor (TCR) with neat diagrams. How to reduce harmonics introduced by three phase TCR? [Diagram required – refer to the original question paper] **(WINTER 2023 OR)**

3. SSSC and Series Compensation:

- **Q.** Discuss static synchronous series compensator. **(SUMMER 2022, 3 Marks OR)**

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