

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BE-6 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK

### Subject Name & Code: **HVDC TRANSMISSION- 3160921**

---

#### Unit 1: HVDC Transmission: The State of Art

##### Repeated Questions:

1. **Compare AC and DC Transmission / Compare AC and DC Transmission (Economics, Technical Performance and Reliability).**  
(W25 - Q1c, 07 Marks), (S25 - Q1a, 03 Marks), (W24 - Q2b, 04 Marks), (S24 - Q1a, 03 Marks), (S23 - Q1c, 07 Marks), (W22 - Q1a, 03 Marks)
2. **Explain various types of HVDC systems / Explain types of DC links / Describe different types of HVDC links.**  
(S25 - Q1c, 07 Marks), (W24 - Q5c, 07 Marks), (S23 - Q1c, 07 Marks), (W22 - Q1b, 04 Marks)
3. **What are the Limitations of HVDC Transmission lines?**  
(S25 - Q1b, 04 Marks), (W24 - Q1b, 04 Marks), (S23 - Q1b, 04 Marks), (S22 - Q1b, 04 Marks)
4. **List out applications of DC transmission.**  
(W25 - Q1a, 03 Marks), (S23 - Q1a, 03 Marks)
5. **List out the Components of a HVDC system / With a neat schematic diagram, state the various apparatus required for HVDC station and explain the purpose of each.**  
(S25 - Q1a, 03 Marks), (S24 - Q3a, 03 Marks), (W22 - Q1c, 07 Marks), (W22 - Q1b, 04 Marks) [Figure given - refer Question paper of W22]

##### Other Important Questions:

1. **In a HVDC system, discuss the impact of delaying the firing angle of thyristors on 1) Average DC Voltage 2) Harmonic Characteristics** (W24 - Q1a, 04 Marks)
  2. **Explain Potential applications of MTDC Systems** (W25 - Q2a, 03 Marks)
  3. **Explain six pulse converter with neat diagram.** (S24 - Q1c, 07 Marks) [Figure given - refer Question paper of S24]
  4. **Explain Line Commutated Converter based HVDC Systems.** (S23 - Q2c, 07 Marks)
  5. **State the relative merits of HVDC transmission and HVAC transmission by taking in to consideration (i) Economics of power transmission (ii) Technical Performance (iii) Reliability** (W22 - Q1a, 03 Marks)
-

## Unit 2: Analysis of Line Commutated Converters

### Repeated Questions:

1. **Explain six pulse converter operation / Draw and explain six pulse converter operation / Using a schematic diagram, describe the operation of a 3-phase, 6-pulse Graetz's circuit.** (S25 - Q2c, 07 Marks), (S24 - Q1c, 07 Marks), (W24 - Q1c, 07 Marks) [Figure given - refer Question paper of W24], (W22 - Q1c, 07 Marks)
2. **Explain twelve pulse converters / Explain twelve pulse converters operation.** (S25 - Q1c, 07 Marks), (S24 - Q2 OR, 07 Marks), (S23 - Q3c, 07 Marks), (W22 - Q2 OR, 07 Marks)
3. **Describe Commutation Process / What is commutation process in HVDC system?** (S25 - Q2a, 04 Marks), (S24 - Q2a, 04 Marks), (W24 - Q4b, 04 Marks), (S23 - Q3b, 04 Marks)
4. **What will happen, when a line commutated converter operates in inverter mode? / What do you mean by Rectifier and Inverter operation?** (S25 - Q2b, 04 Marks), (S25 - Q3a, 03 Marks), (S24 - Q2b, 04 Marks)
5. **Analyze the effect of delaying the firing angle. / Explain effects of firing angle delay in line commutated converters. / What will be the Effect of Delaying the Firing Instant?** (S25 - Q2c, 07 Marks), (S25 - Q2 OR, 07 Marks), (S24 - Q2c, 07 Marks), (S23 - Q3a, 03 Marks)

### Other Important Questions:

1. **Explain basic principle of three-phase AC-DC conversion.** (S22 - Q2a, 03 Marks)
  2. **Distinguish between delay in firing angle  $\alpha$  and extinction angle  $\gamma$  of an HVDC converter. Explain the operation of a converter when working as an inverter, and state the necessary conditions required for inverter operation.** (W22 - Q2c, 07 Marks)
  3. **Sketch the waveforms of output voltage and the transformer secondary current in the case of 3-phase, 6 pulse bridge circuit (Graetz's circuit).** (W22 - Q2a, 03 Marks) [Figure given - refer Question paper of W22]
  4. **Explain Basic Principal of three-phase AC- DC Conversion, six pulse converter operation.** (S23 - Q3c, 07 Marks)
  5. **Explain in brief Configuration and operation of Line Commutated Converters (LCCs).** (W25 - Q3c, 07 Marks)
-

### Unit 3: Voltage Source Converters (VSCs)

**Repeated Questions:**

1. **Explain VSC operating principle / Write down only VSC Operating Principle.**  
(S22 - Q3a, 03 Marks), (S23 - Q4a, 03 Marks)
2. **Explain Selective Harmonic Elimination / How to do selective harmonic elimination? / What is selective harmonic elimination technic? How to eliminate selective harmonics?**  
(S25 - Q4c, 07 Marks), (S22 - Q3a, 03 Marks), (W22 - Q4b, 04 Marks)
3. **Explain Sinusoidal Pulse Width Modulation / With sketch explain Sinusoidal Pulse Width Modulation.**  
(S22 - Q3c, 07 Marks), (W22 - Q4b, 04 Marks) [Figure given - refer Question paper of W22]
4. **Classify PWM techniques.**  
(S25 - Q4b, 04 Marks), (S24 - Q4b, 04 Marks), (S24 - Q3a, 03 Marks)
5. **Explain "Phase-Locked Loop"**  
(S25 - Q4b, 04 Marks), (S24 - Q4b, 04 Marks), (W24 - Q4a, 03 Marks)

**Other Important Questions:**

1. **Discuss PWM schemes in detail.** (S23 - Q4c, 07 Marks)
  2. **Explain Phase Lock Loop (PLL).** (S23 - Q4b, 04 Marks)
  3. **Explain Naturally Sampled PWM.** (W25 - Q4a, 03 Marks)
  4. **Explain Uniformly Sampled PWM.** (W25 - Q5a, 03 Marks)
  5. **Equation in rotating reference frame. / Explain rotating reference frame theory.** (S24 - Q4c, 07 Marks), (S25 - Q4c, 07 Marks)
-

## Unit 4: Control of HVDC Converters and System

### Repeated Questions:

1. **Explain principles of DC Link Control in a VSC based HVDC system.**  
(S25 - Q4b, 04 Marks), (W24 - Q4a, 03 Marks), (S23 - Q4c, 07 Marks), (W22 - Q4a, 03 Marks)
2. **Explain real and reactive power control using VSC. / Explain Reactive Power Control / AC voltage regulation using VSC. / How Real and Reactive power control using a VSC?**  
(S25 - Q4c, 07 Marks), (S24 - Q3c, 07 Marks), (S23 - Q4a, 03 Marks), (W25 - Q3c, 07 Marks)
3. **Explain principles of DC Link control in a LCC HVDC system. / Explain Principles of DC Link control in LCC HVDC systems.**  
(S25 - Q4b, 04 Marks), (W25 - Q3a, 03 Marks), (W24 - Q5b, 04 Marks), (W22 - Q4a, 03 Marks)
4. **Explain firing angle control. / For a HVDC system discuss the firing angle control with appropriate firing scheme.**  
(S22 - Q3b, 04 Marks), (W24 - Q2 OR, 07 Marks)
5. **Explain power flow and dc voltage control in VSC based HVDC system.**  
(S24 - Q3c, 07 Marks), (S23 - Q3c, 07 Marks)

### Other Important Questions:

1. **What is Current and Extinction Angle Control?** (S24 - Q4a, 03 Marks)
  2. **Explain current and extinction angle control of HVDC Converters and System.** (W25 - Q5c, 07 Marks)
  3. **Explain control and Protection of MTDC systems.** (W25 - Q2 OR, 07 Marks)
  4. **Explain in detail control of power in MTDC.** (S25 - Q4c, 07 Marks), (S24 - Q4c, 07 Marks)
  5. **Write short note on high level controllers. / What are the various Higher-level Controllers? Explain any one in detail.** (S25 - Q3c, 07 Marks), (S22 - Q3c, 07 Marks)
  6. **What is the Importance of Reactive power?** (S23 - Q3a, 03 Marks)
  7. **State difference in power control in HVDC and HVAC systems and explain the necessity of power control in an HVDC link.** (W22 - Q3a, 03 Marks)
  8. **Explain the operation of pulse frequency control and state why it is preferred in modern HVDC systems?** (W22 - Q3b, 04 Marks)
  9. **What do you understand by constant extinction angle control? What are the parameters that should be taken in to account while designing constant extinction angle controller?** (W22 - Q3c, 07 Marks)
  10. **Explain starting and stopping of an HVDC link. / Describe the process involved in starting and stopping a DC link in a HVDC system.** (W22 - Q3a, 03 Marks), (W24 - Q2c, 07 Marks)
-

## Unit 5: Components of HVDC Systems

### Repeated Questions:

1. **Explain DC line faults in LCC systems.**  
(W25 - Q3b, 04 Marks), (S25 - Q5a, 03 Marks), (S22 - Q5a, 03 Marks)
2. **Explain DC line faults in VSC systems.**  
(S25 - Q5b, 04 Marks), (S22 - Q5 OR a, 03 Marks), (W25 - Q4b, 04 Marks)
3. **Write short note on "corona effect". / Explain corona effects in DC line.**  
(S25 - Q3b, 04 Marks), (S24 - Q3b, 04 Marks), (W25 - Q4b, 04 Marks), (S23 - Q5b, 04 Marks)
4. **Write short note on DC breaker. / Explain DC breakers. / Discuss in details: DC Circuit Breakers.**  
(S25 - Q3b, 04 Marks), (S24 - Q3b, 04 Marks), (W24 - Q5b, 04 Marks), (W25 - Q3a, 03 Marks)
5. **Explain function of smoothing reactors in HVDC system. / What is the function of smoothening reactor? / What is the role of Smoothing Reactors?**  
(S22 - Q4a, 03 Marks), (S24 - Q3a, 03 Marks), (S23 - Q5a, 03 Marks)

### Other Important Questions:

1. **Explain mono-polar operation of HVDC.**  
(S25 - Q3c, 07 Marks), (S24 - Q5c, 07 Marks), (W24 - Q4c, 07 Marks)
  2. **Compare Active filters and Passive filters.** (W25 - Q5b, 04 Marks)
  3. **Explain function of DC line insulators in HVDC systems.** (W25 - Q3b, 04 Marks)
  4. **Enlist different types of insulators. Explain all in short.** (W22 - Q4c, 07 Marks)
  5. **What are their requirements? How are insulators for DC different from that for AC?** (W22 - Q4b, 04 Marks)
  6. **Explain function of Ground Electrodes in HVDC system.** (S22 - Q4a, 03 Marks)
  7. **Mention the essential requirements of ground electrodes in HVDC systems and explain the necessity of each item briefly.** (W22 - Q4a, 03 Marks)
  8. **Describe the impact of transient over- voltages on LCC HVDC systems.** (W24 - Q5a, 03 Marks)
  9. **Give the principle of different types of DC circuit breaker schemes. Why is a surge diverter needed across the DC circuit breaker.** (W22 - Q5c, 07 Marks)
  10. **Discuss how reactive power sources influence the stability of HVDC systems.** (W24 - Q5 OR a, 03 Marks)
  11. **Explain applications of DC breakers.** (W25 - Q3a, 03 Marks)
-

## Unit 6: Stability Enhancement Using HVDC Control

### Repeated Questions:

1. **Explain basic principles of synchronous and asynchronous links. / Differentiate between synchronous and asynchronous link. / Compare: Synchronous & Asynchronous Link** (S25 - Q5a, 03 Marks), (S24 - Q5a, 03 Marks), (S23 - Q5a, 03 Marks), (W24 - Q3b, 04 Marks)
2. **Describe voltage stability problem in AC/DC systems. / Discuss Voltage Stability Problem in AC/DC systems.** (S25 - Q5c, 07 Marks), (S22 - Q5b, 04 Marks), (S23 - Q5c, 07 Marks)

### Other Important Questions:

1. **Explain classification of power system stability.** (W25 - Q5b, 04 Marks)
  2. **Explain analysis of voltage stability in asynchronous AC- DC System.** (W25 - Q5c, 07 Marks)
  3. **Write down a Principle of Power modulation.** (S25 - Q4a, 03 Marks), (S23 - Q5a, 03 Marks)
  4. **How to enhance frequency stability using HVDC control. / Discuss how HVDC system can enhance the frequency stability.** (S24 - Q5b, 04 Marks), (W24 - Q2a, 03 Marks)
  5. **List out the advantages of utilizing asynchronous link for power transmission.** (W24 - Q3 OR b, 04 Marks)
  6. **Explain mitigation steps for reducing the impact of Corona in HVDC Transmission networks.** (W24 - Q3 OR a, 03 Marks)
  7. **Explain Parallel Operation of HVDC. / Explain parallel operation of HVDC system.** (S24 - Q5b, 04 Marks), (S23 - Q5b, 04 Marks)
-

## Unit 7: Multi Terminal HVDC System

### Repeated Questions:

1. **Explain types of multi-terminal HVDC System. / List out the Types of Multi-terminal HVDC System. / Explain about multi-terminal HVDC system.**  
(S25 - Q4a, 03 Marks), (S22 - Q5c, 07 Marks), (S23 - Q5b, 04 Marks), (S24 - Q5b, 04 Marks)
2. **Explain control of power in MTDC.**  
(S24 - Q5c, 07 Marks), (S22 - Q4c, 07 Marks)

### Other Important Questions:

1. **Explain Types of Multi-terminal HVDC Systems.** (W25 - Q2b, 04 Marks)
2. **Why are multiterminal DC systems needed? What are the different types of MTDC systems used?** (W22 - Q5a, 03 Marks)
3. **How is power sharing and power control achieved in an MTDC systems.** (W22 - Q5b, 04 Marks)
4. **Explain different aspects to be considered for a parallel operation in MTDC systems.** (W22 - Q5 OR c, 07 Marks)
5. **Discuss the working and requirements of MTDC. Enlist various types of MTDC used.** (W24 - Q5c, 07 Marks)
6. **Explain Modular multi-level converters. / What is modular multilevel converter? / Discuss: Modular multilevel converters**  
(S25 - Q5b, 04 Marks), (S22 - Q5c, 07 Marks), (W22 - Q5 OR b, 04 Marks), (W24 - Q5 OR c, 07 Marks)
7. **Write a short note on "Modern Trends in HVDC Technology."** (S25 - Q5c, 07 Marks), (S23 - Q5c, 07 Marks)
8. **Explain multi-level converter.** (S24 - Q4a, 03 Marks)

\*\*\*\*\*