Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024**

**Subject Code:3160921 Date:24-05-2024**

**Subject Name:HVDC Transmission Systems**

**Time:10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | 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 | **03** |
| | **(b)** | Explain with neat sketch different types of HVDC links (i) Monopolar HVDC link (ii) Bipolar Homopolar HVDC link and (iii) Homopolar HVDC link. | **04** |
| | **(c)** | With a neat schematic diagram, state the various apparatus required for HVDC station and explain the purpose of each. | **07** |
| **Q.2** | **(a)** | Sketch the waveforms of output voltage and the transformer secondary current in the case of 3 – phase, 6 pulse bridge circuit (Graetz's circuit) | **03** |
| | **(b)** | Identify the various sources for generation of harmonics in HVDC systems and mention the various adverse effects caused due to the presence of harmonics. | **04** |
| | **(c)** | Distinguish between delay in firing angle $\alpha$ and extinction angle $\Upsilon$ of an HVDC converter. Explain the operation of a converter when working as an inverter, and state the necessary conditions required for inverter operation. | **07** |
| | | **OR** | |
| | **(c)** | Explain 12 pulse converter with schematic diagram. | **07** |
| **Q.3** | **(a)** | State difference in power control in HVDC and HVAC systems and explain the necessity of power control in an HVDC link. | **03** |
| | **(b)** | Explain the operation of pulse frequency control and state why it is preferred in modern HVDC systems? | **04** |
| | **(c)** | 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? | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain starting and stopping of an HVDC link. | **03** |
| | **(b)** | Explain the relative merits and demerits of constant current and constant voltage operation of an HVDC link. | **04** |
| | **(c)** | Explain real and reactive power control using VSC. | **07** |
| **Q.4** | **(a)** | Explain principles of DC Link control in a LCC HVDC system. | **03** |

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| | **(b)** | Describe selective harmonic elimination techniques. | **04** |
| | **(c)** | Explain basic principles of synchronous and asynchronous links. | **07** |

**OR**

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| **Q.4** | **(a)** | Mention the essential requirements of ground electrodes in HVDC systems and explain the necessity of each item briefly. | **03** |
| | **(b)** | How are insulators for DC different from that for AC? What are their requirements? | **04** |
| | **(c)** | Write notes on voltage stability problems in HVAC/DC systems. | **07** |
| **Q.5** | **(a)** | Why are multiterminal DC systems needed? What are the different types of MTDC systems used? | **03** |
| | **(b)** | How is power sharing and power control achieved in an MTDC systems. | **04** |
| | **(c)** | Give the principle of different types of DC circuit breaker schemes. Why is a surge diverter needed across the DC circuit breaker. | **07** |

**OR**

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| **Q.5** | **(a)** | Classify PWM techniques. | **03** |
| | **(b)** | What is modular multilevel converter? | **04** |
| | **(c)** | Explain different aspects to be considered for a parallel operation in MTDC systems. | **07** |

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