High Voltage DC Transmission - Web course

COURSE OUTLINE

In early invention of electric energy, dc power was used but due to limitations of low voltage dc systems, ac systems become popular. With increase interconnection and loading of power system, the factors such as are reactive power, stability, power control, etc, impose limitations on the amount of power to be transmitted over ac lines. With advent of high voltage semiconductor devices, it has been possible to go for high voltage dc (HVDC) transmission for long distance power transfer.

Semiconductor technology enabled the manufacture of powerful thyristors and later of new elements such as the gate turn-off thyristors (GTO) and gate bipolar transistors (IGBT). Development based on the semiconductor devices first established high voltage DC transmission (HVDC) technology as an alternative to long distance ac transmission.

There are still several limitations of HVDC transmission. Therefore, the transmission system is mixed of HVAC and HVDC systems. This course will provide in-depth knowledge of HVDC system, converter topology, control of HVDC system, filters, analysis of HVDC/HVAC systems, etc.

Contents: Evolution of HVDC systems, comparison of HVAC and HVDC transmission systems, components of HVDC transmission system, analysis of HVDC converters, HVDC control, mal-operation and protection of converters, filter design, AC/DC load flow and stability analysis, multi-terminal HVDC, different application of HVDC system, advances in HVDC systems.

COURSE DETAIL

Sl. No	Topic	No. of Hours
Module-I	1. Evolution of HVDC Transmission. 2. Comparison of HVAC and HVDC systems. 3. Type of HVDC Transmission systems. 4. Components of HVDC transmission systems.	04
Module-II	1. Analysis of simple rectifier circuits. 2. Required features of rectification circuits for HVDC transmission. 3. Analysis of HVDC converter. a. Different modes of converter operation. b. Output voltage waveforms and DC voltage in rectification. c. Output voltage waveforms and DC in inverter operation. d. Thyristor voltages.	10

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Electrical Engineering

Pre-requisites:

1. Basic Undergraduate Course on Power Systems, Power Electronics.

Additional Reading:

1. Research Papers.

Coordinators:

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	4. Equivalent electrical circuit.	
Module-III	1. HVDC system control features. 2. Control Modes. 3. Control Schemes. 4. Control comparisons.	05
Module-IV	1. Converter mal-operations. 2. Commutation failure. 3. Starting and shutting down the converter bridge. 4. Converter protection.	06
Module-V	1. Smoothing reactor and DC Lines. 2. Reactive power requirements. 3. Harmonic analysis. 4. Filter design.	06
Module-VI	1. Component Models for the Analysis of AC DC Systems. 2. Power flow analysis of AC-DC systems. 3. Transient stability analysis. 4. Dynamic stability analysis.	06
Module-VII	1. Multi-terminal HVDC system. 2. Advances in HVDC transmission. 3. HVDC system application in wind power generation.	05

References:

1. KR Padiyar, "*HVDC Power Transmission Systems*", Willey Eastern Limited, Second edition.
2. J Arrillaga, "*High Voltage Direct current Transmission*", Peter Peregrinus Ltd, UK.
3. EW Kimbark, "*Direct Current Transmission*", Wiley-Interscience, New York.
4. SN Singh, "*Electric Power Generation, Transmission and Distribution*, PHI, New Delhi 2nd edition, 2008.