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| 7th Semester | REL7D002 | High Voltage Systems and DC Transmission | L-T-P 3-0-0 | 3 Credits |
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Module I:**(10 Hours)**

Introduction: Design, planning and layout of H.V. laboratories Conduction and breakdown in Gaseous Dielectrics: Townsend's current growth equation, current growth in the presence of secondary processes, and streamer theory of breakdown in gases. Breakdown in non-uniform fields and corona. Conduction and Breakdown in Liquid dielectrics: Pure liquids and commercial liquids, conduction and breakdown in commercial liquids. Breakdown and pre-breakdown phenomena in solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, thermal breakdown.

Module II:**(10 Hours)**

Generation of High voltages: Generation of high D.C. voltage, high A.C. voltage, impulse voltage, impulse current, tripping and control of impulse generators. Measurement of high voltages and current: Measurement of high D.C., A.C. and impulse. Measurement of D.C. resistivity, dielectric constant and loss factor, partial discharge and Condition monitoring. H.V. Testing of Electrical Apparatus: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, and surge diverters.

Module III:**(12 Hours)**

HVDC Transmission System: DC Power Transmission Technology: Introduction, Comparison of AC and DC Transmission, Application. Analysis of HVDC Converters: Choice of converter configuration, Graetz circuit, Converter bridge characteristics, Characteristics of a twelve pulse converters, Converter and HVDC system Control: Principles of DC Link control, Converter control characteristics, System control hierarchy Firing angle control, current and extinction angle control, Starting and stopping of DC link, Power Control.

Module IV:**(6 Hours)**

Smoothing Reactor and DC Line: Smoothing reactors, DC Line, transient over voltages in DC Line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC Transmission lines. Reactive Power Control: Reactive power requirements in steady state, Sources of reactive power, Static var systems, Reactive power control during transients. Harmonics and Filters: Generation of Harmonics, Design of AC Filters, DC Filters, Carrier frequency and RI noise. Multiterminal DC systems: Potential applications of MTDC systems, Types of MTDC systems, control and protection of MTDC systems, Control and protection of MTDC Systems study of MTDC systems.

Books:

- [1] M. S. Naidu and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, 1995
- [2] E.W. Kimbark, *Direct Current Transmission-vol.1*, Wiley Inter science, New York , 1971
- [3] J. Kuffel and W. S. Zaengl, *High Voltage Engineering: Fundamentals*, Newnes, 2000
- [4] J. Arrillaga, *HVDC Transmission*, IET, Peter Peregrinver Ltd., London, U.K, 1998

Digital

Course Name: High Voltage Engineering
Course Link: <https://nptel.ac.in/courses/108/104/108104048/>
Course Instructor: Prof. Ravindra Arora, IIT Kanpur

Course Name: High Voltage DC Transmission
Course Link: <https://nptel.ac.in/courses/108/104/108104013/>
Course Instructor: Dr. S.N. Singh, IIT Kanpur

Learning Resources: