

HIGH VOLTAGE ENGINEERING
(Professional Elective-II)

Prerequisites: Power Systems-II

Course Objectives:

This course deals with

1. The breakdown phenomenon in gaseous, liquids and solids dielectrics
2. Generation and measurements of High voltages and currents
3. Over voltages Phenomenon and Protection against over voltages
4. Testing of electrical apparatus and layout of HV laboratories

Unit 1: (~14 Lecture Hours)

Breakdown in Gases, liquid and solid Insulating materials

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge. Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, applications of insulating materials.

Unit 2 : (~7 Lecture Hours)

Generation of High Voltages

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Unit 3: (~7 Lecture Hours)

Measurements of High Voltages and Currents

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 4: (~8 Lecture Hours)

Lightning and Switching Over-voltages

Charge formation in the clouds- Rate of charging of Thunder clouds, Stepped leader, Dart leader, Mechanism of Lightning Surges. Origin of Switching Surges, Characteristics of Switching Surges, Switching over-voltages in EHV and UHV Systems. Protection against over-voltages-Surge diverters For EHV systems, Protection of lines with surge diverters.

- | | | |
|---------------------|-----------------|------------------------|
| 1) N. Muthukrishnan | 6) [Signature] | 11) [Signature] |
| 2) [Signature] | 7) [Signature] | 12) [Signature] |
| 3) [Signature] | 8) [Signature] | 13) [Signature] |
| 4) [Signature] | 9) [Signature] | 14) [Signature] |
| 5) [Signature] | 10) [Signature] | 15) [Signature] |
| | | 16) R. Balasubramaniam |

27/74

Unit 5 : (~9 Lecture Hours)

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and Surge arresters, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age Science; Third Edition , 2010.
3. Subir Ray , "An Introduction to High Voltage Engineering", Second Edition, 2013

Reference Books:

1. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
2. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", JohnWiley & Sons, 2011.
3. Various IS standards for HV Laboratory Techniques and Testing.

NOTE: Visit to HV Laboratories is Preferable

Course outcomes:

At the end of the course, the student will demonstrate

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of different types of high voltages and currents.
- Phenomenon of over voltages in a power system and the protection against over-voltages.
- Knowledge of tests on H. V equipment as per the standards.
- Knowledge on layout of HV laboratories.

1) N. M. Mehta
2) T. S. Subramanian
3) S. K. Ghosh
4) S. K. Ghosh
5)

6) H. V. Gupta
7) M. S. Naidu
8) K. V. K. Reddy
9) S. K. Ghosh
10) S. K. Ghosh

11) R. S. Ghosh
12) G. S. Ghosh
13) K. V. K. Reddy
14) S. K. Ghosh
15) M. S. Naidu
16) R. S. Ghosh