Course Type	Course Code	Name of Course	L	T	P	Credit
DE	EED402	High Voltage Engineering and Applications	3	0	0	9

Course Objective

This syllabus has been designed with an eye on power engineering, and the topics considered are intricately related to power-engineering applications in general and dielectric engineering in particular. The course will give a brief overview of High Voltage Engineering. The course will also give an insight into important topics like insulation coordination, partial discharge corona which are considered as necessary knowledge and need of the day for any student who desires to be a power engineer.

Learning Outcomes

Upon successful completion of this course, students will:

- understand the fundamentals of different aspects in High Voltage Engineering
- understand the fundamentals of High voltage generation, measurement and testing
- gain knowledge about latest developments in the field of insulation material design, its diagnosis and testing.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Types of Insulators and their applications, Voltage distribution and string efficiency of disc insulators Bushings, Field distribution in and around bushings	3	Understanding of basic principles and need of surveying.
2	Evolution of high voltage cables, XLPE cables, Gas-filled cables, Capacitance grading, Inter-sheath grading, Thermal characteristics of cables,	6	Understanding the basics of different construction methods - merits/demerits; insulation material properties and characteristics
3	Gas Insulated Substation – Layout and Components, Gas mixtures and their properties; Insulation coordination scheme of open-air substation, Basic Impulse Level,	4	Understanding the basics of Gas Insulated substation and gaining knowledge about Insulation Coordination
4	Types of HV insulating material and its properties; Breakdown mechanism in dielectrics; Oil impregnated paper; Dry insulation; Alternate dielectric liquids; nano-dielectric; Voltage distribution in transformer winding and bushings; Application of Statistical analysis in HV	6	Knowledge about different types of solid and liquid insulations used in industry
5	Corona discharge - Corona Loss and radio interference, Partial Discharge Measurement and analysis – Electrical method of PD measurement, PD inception and Extinction in closed cavity; back flashover. Fault current limiters – introduction	5	Knowledge about Corona discharges and different breakdown mechanisms in insulators. partial discharge – their
6	Causes of lightning over voltages, Interaction between lightning and power system, switching surges and power-frequency over voltages, Basic idea about protection against over voltages, Lightning arresters and surge suppressors, Ground wires, Grounding practices, critical flashover voltage, Tower footing resistance; Line terminations, Ladder diagram, Travelling waves in multi-conductor systems;	6	In depth knowledge about lightning phenomenon, its interaction with tower, earthed structures and associated over voltages
7	Generation of High AC Voltage –Transformer in cascade; Testing transformer and interleaved winding; single-phase series resonance circuit; Generation of High DC Voltage – Single-stage; multi-stage - symmetric as well as asymmetric voltage multiplier circuits, Generation of Impulse Voltage – Single-stage and multi-stage impulse generators circuits, Triggering and synchronization;	6	Knowledge about techniques available for generation of AC/DC high voltage and their application in Electrical Engineering

8	Measurement of Peak value of high AC Voltage – Chubb & Fortescue Method, Frequency independent methods: Davis-Bowdler Method, Rabus Method, Sphere-Gap Method; Measurement of RMS value of high AC Voltage; Capacitive Voltage Transformer, Potential Dividers, Electrostatic Voltmeter; Measurement of High DC Voltage – Ammeter in series with high resistance Measurement of Dielectric Loss-factor – High Voltage Schering Bridge; Non-destructive High Voltage Testing: Testing of insulators, transformers, isolators, circuit breakers and cables; Remaining life estimations	6	An in-depth knowledge about techniques available for measuring AC/DC high voltageapplication areas

Text Books

1. High Voltage Engineering by Farouk A.M. Rizk, Gian N Trinh
2. High Voltage Engineering: Fundamentals by E. Kuffel, W.S. Zaengl, J. Kuffel

Reference Books

1. High Voltage Engineering by Andreas Kuchl