HIGH VOLTAGE ENGINEERING

V Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE015	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			

OBJECTIVES:

The students will try to learn:

I The breakdown phenomena in gas, liquid and solid dielectric materials used in the high voltage devices.

II The circuit design and operation for generation of high DC, AC and impulse voltages.

III The different methods for measurement and testing of equipments used in the high voltage engineering.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1 **Recall the protection methods against over voltages and working of lightning arrester for protecting various equipments in power system.**

CO 2 **Summarize the breakdown phenomena of various types of dielectric materials for identifying withstands levels.**

CO 3 **Illustrate the breakdown mechanism of solids, liquids and gases to measure their strength in an insulating medium.**

CO 4 **Demonstrate the various techniques for generating high voltages and currents for testing various apparatus.**

CO 5 **Explain the methods of generation of impulse voltage and currents for controlling and triggering of impulse generators.**

CO 6 **Interpret the necessity of measuring voltages and currents accurately, ensuring perfect safety to the person as well as equipment.**

CO 7 **Apply analytical and numerical techniques for electric field calculations in high voltage systems.**

CO 8 **Identify Insulation coordination and insulation levels for testing various parts of power system.**

CO 9 **Make use of various non destructive test techniques used for testing of high voltage electrical apparatus.**

CO 10 **Outline the principles of insulation coordination on high voltage and extra high voltage power systems to suppress the over voltages.**

MODULE-I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS

Origin of over voltages: Causes of over voltages and their effects on power system, lightning, switching surges and temporary over voltages, corona and its effects, reflection and refraction of travelling waves, protection against over voltages. Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters and Surge modifiers.

MODULE-II	DIELECTRIC BREAKDOWN
Breakdown of dielectrics: Gaseous breakdown in uniform and non uniform fields, corona discharges, breakdown of vacuum, conduction and breakdown in pure and commercial liquids, maintenance of oil quality, breakdown mechanisms in solid and composite dielectrics.	
MODULE-III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**
High AC, DC voltages and currents: Generation of high DC, AC and impulse voltages and currents. Triggering: Triggering and control of impulse generators.	
MODULE-IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**
High voltage and current measurement: High resistance with series ammeter, dividers, resistance, capacitance and mixed dividers, peak voltmeter, generating voltmeters, capacitance voltage transformers, electrostatic voltmeters, sphere gaps, high current shunts, digital techniques in high voltage measurement.	
MODULE-V	**HIGH VOLTAGE TESTING AND INSULATION COORDINATION**
Testing: High voltage testing of electrical power apparatus as per international and Indian standards, power frequency, impulse voltage and dc testing of insulators, circuit breakers, bushings, isolators and transformers, insulation coordination.	

Text Books:

1. S Naidu, V Kamaraju, “High Voltage Engineering”, Tata McGraw-Hill, 5th Edition, 2013.
2. E Kuffel, W S Zaengl, J Kuffel, “High voltage Engineering fundamentals”, Newnes, 2nd Edition Elsevier, New Delhi, 2005.
3. Subir Ray, “An Introduction to High Voltage Engineering”, PHI Learning Private Limited, New Delhi, 2nd Edition, 2013.

Reference Books:

1. L L Alston, “High Voltage Technology”, Oxford University Press, 1st Indian Edition, 2011.
2. C L Wadhwa, “High Voltage Engineering”, New Age International Publishers, 3rd Edition, 2010.

Web References:

1. https://www.nptel.ac.in/courses/108104048/
2. https://www.hve.iisc.ernet.in/
3. https://www.ee.iisc.ac.in/research-hve.php
4. https://www.wikipedia.org/wiki/High_voltage
5. https://www.annauniv.edu/HighVoltage/