Kadi Sarva Vishwavidyalaya

Faculty of Engineering & Technology

Third year Bachelor of Engineering (EE)

With effect from: Academic Year 2019-20

Subject Code: EE604-N	Subject Title: High Voltage Engineering
Pre-requisite	

Course Objective:

- To present a problem oriented introductory knowledge of HVAC and HVDC.
- To understand the generation of HVAC and HVDC.
- To measurement of HVAC, HVDC and also over voltages.
- To understand the Break down in Solid, Liquid and Gas.

Teaching scheme				Total Credit	Evaluation Scheme					Total Marks
L	T	P	Total		Theory		IE Marks	CIA Marks	Pract. Marks	
Hrs	Hrs	Hrs	Hrs		Hrs	Marks				
04	00	02	06	05	03	70	30	20	30	150

Outline of the Course:

Sr. No	Title of the Unit	Minimum Hours
1	**Electrostatic fields and field stress control**	10
2	**Electrical breakdown in gases**	8
3	**Breakdown in liquid and solid dielectrics**	10
4	**Generation of high voltages**	12
5	**Measurement of high voltages**	10
6	**High voltage testing**	10

Total Hours (Theory): 60
Total Hours (Lab): 30
Total Hours: 90

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Detailed Syllabus

Sr. No	Topic	Lecture Hours	Weightage(%)
1	**Electrostatic fields and field stress control:** Electrical field distribution and breakdown strength of insulating materials -fields in homogeneous, isotropic materials - fields in multi-dielectric, isotropic materials - numerical method: charge simulation method (CSM)	10	**20**
2	**Electrical breakdown in gases:** Gases as insulating media - ionization and decay processes, Townsend first ionization coefficient, photoionization, ionization by interaction of metastable with atoms, thermal ionization, deionization by recombination, deionization by attachment– negative ion formation, mobility of gaseous ions and deionization by diffusion, relation between diffusion and mobility, examples - cathode processes – secondary effects, photoelectric emission, electron emission by positive ion and excited atom impact, thermionic emission, field emission, Townsend second ionization coefficient, secondary electron emission by photon impact, examples - transition from non-self-sustained discharges to breakdown, the Townsend mechanism.	8	**12**
3	**Breakdown in liquid and solid dielectrics:** Liquid as insulators, breakdown in liquids - electronic breakdown, suspended solid particle mechanism, cavity breakdown, electro-convection and electro-hydrodynamic model of dielectric breakdown, examples – static electrification in power transformers, transformer oil filtration, transformer oil test, alternative liquid insulations like vegetable oils, esters and silicon oils - breakdown in solids, intrinsic breakdown, streamer breakdown, electromechanical breakdown, edge breakdown and treeing, thermal breakdown, erosion breakdown, tracking - breakdown of solid dielectrics in practice, partial discharges in solid insulation, solid dielectrics used in practice	10	**20**
4	**Generation of high voltages :** Generation of high direct voltages, half and full wave rectifier circuits, voltage multiplier circuits, Van de Graff generators, electrostatic generators, examples - generation of alternating voltages, testing transformers, cascaded transformers, resonant transformers, examples - impulse voltages, impulse voltage generator circuits, Marx circuit, operation, design and construction of impulse generators, examples - impulse current generator - control systems	12	**20**
5	**Measurement of high voltages :** High direct voltage measurement, peak voltage measurements by spark gaps, sphere gaps, reference measuring systems, uniform field gaps, rod gaps, factors affecting sphere gap measurements, examples – electrostatic voltmeters - ammeter in series with high ohmic resistors and high ohmic resistor voltage dividers – generating voltmeters and field sensors – the measurement of peak voltages, the Chubb–Fortescue method, highvoltage capacitors for measuring circuits - voltage dividing systems and impulse voltage measurements.	10	**15**

6	**High voltage testing:** Testing of insulators and bushings - testing of isolators and circuit breakers - testing of cables - testing of transformers - testing of surge diverters - radio interference measurements - design, planning and layout of high voltage laboratory.	10	**13**
	Total	**60**	**100**

Learning Outcome

On successful completion of the course

- The student can be acquired the basic knowledge of high voltage generation.
- The student can be able to know the breakdown strength of Solid, Liquid and gas.
- The students will be able to effectively employ HVAC and HVDC to the exploration of new applications and techniques for their use.

TEXT BOOKS:

- Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi, , 2009.

REFERENCE BOOKS:

- Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers
- Ravindra Arora and Wolfgang Mosch, "High Voltage - Insulation Engineering", first edition, New Age International Publishers Limited.
- Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions".
- Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering : Fundamentals" Butterworth-Heinmann (A division of Reed Educatonal & Profession PublishingLimited), 2nd Edition, 2000.

List of experiments:

Sr. No.	Name of experiment
1.	To study about high voltage laboratories & it's lay out.
2.	To perform breakdown in gaseous dielectric by horn gap apparatus.
3.	To measure the dielectric strength of oil by 0-60 kV oil test kit.
4.	To measure the dielectric strength of solid dielectric by 0-30 kV insulation tester.
5.	To plot the equipotential lines of various electrodes by electrolytic tank.
6.	To perform impulse generation test by 150kV, 225J impulse generator test kit.
7.	To measure HVDC by sphere gap assembly.
8.	To measure HVAC by sphere gap assembly.
9.	To measure the dielectric strength of air by rod gap assembly with various types of electrodes.
10.	To study about corona with corona cage.