Department of Electrical and Electronics Engineering

COURSE MODULES OF THE SUBJECT TAUGHT FOR THE ODD SEMESTER 2025-26

Course Syllabi with CO's

Faculty Name: Mr. Raghavendra L			**Academic Year:** 2025-2026				
Department: Electrical and Electronics Engineering							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
BEE515A	**High Voltage Engineering**	**Core**	Basic Electrical, Engineering Physics, Measuring Instruments	**3**	**0**	**0**	**40 + 10 Extra Classes**
Course Objectives	1. To understand the conduction and breakdown mechanism in gases, liquid and solid dielectrics. 2. To know about the generation of high voltages and currents and their measurement. 3. To understand the various types of over voltages phenomena and protection methods. 4. To discuss non-destructive testing of materials and electric apparatus. 5. To discuss high-voltage testing of electrical equipment.						
Topics Covered as per Syllabus							

Module-1

Introduction: Electric field stress, gas, liquid, solid and composite dielectrics.

Conduction and Breakdown in Gases: Gases as Insulating Media, Collision Process – types of collision, Mobility of ions and electrons. Ionization Processes- Ionization by collision. Townsend's Current Growth Equation--Current Growth in the Presence of primary and Secondary Processes, Townsend's Criterion for Breakdown, Breakdown in Electronegative Gases, Time Lags for Breakdown, Paschen's Law, Corona Discharges.

Conduction and Breakdown in Liquid Dielectrics: purification of liquid dielectrics, Breakdown in Liquid dielectrics. - Suspended particle, bubble and stressed oil volume mechanism.

Conduction and Breakdown in Solid Dielectrics: Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown. **8 Hours**

Teaching-Learning Process : Chalk and Board, Power Point Presentation.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding

Module-2

Generation of High Direct Current Voltages: Voltage Doubler circuit, Voltage multiplier circuit- Cockcroft Walton circuit, Ripple and voltage drop in multiplier circuit. Vandegraaff generator.

Generation of High Alternating Voltages: Cascade transformers, Resonant transformers, Tesla coil.

Generation of Impulse Voltages and currents: Standard impulse wave, Circuit for producing impulse waves- Analysis of impulse generator RLC circuit, Wave shape control, Marx circuit.

Generation of impulse current: standard impulse current wave, Circuit for producing impulse current wave. **8 Hours**

Teaching-Learning Process : Chalk and Board, Power Point Presentation.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying , L4 – Analysing.

Module-3

Measurement of High DC Voltages and Currents: Measurement of High DC Voltages – Series Resistance micro ammeter, Resistance potential divider, Generating voltmeter.

Measurement of High AC voltages- Series impedance voltmeter, Series capacitance voltmeter, Capacitance potential dividers, Capacitance voltage transformers. Electrostatic voltmeter, series capacitance peak voltmeter (chubb-Fortscue method), Spark gaps for measurement of High dc, ac and Impulse voltages - Spark gap measurements, Factors influencing the spark over voltage of sphere gaps.

Measurement of Impulse Voltages – Resistance potential dividers, capacitance voltage dividers, Mixed R-C potential dividers Peak reading voltmeters for impulse voltages.

Measurement of High DC, AC and impulse Currents - Hall generator, Resistive shunt, Rogowski coils and Magnetic links. **8 Hours**

Teaching-Learning Process : Chalk and Board, Power Point Presentation.

Department of Electrical and Electronics Engineering

Module-4

Natural Causes for Over voltages

Lightning phenomenon –Charge formation in the clouds, Mechanism of lightning strokes, Mathematical model for lighting, Overvoltages due to indirect stroke.

Power frequency Overvoltage- Sudden load rejection, Ferranti effect. Control of overvoltages due to switching.

Protection of transmission lines against overvoltages- Using shielded or ground wires, Ground rods and counter poise wires, Surge arresters -Protector tubes, and Nonlinear element surge arrestors.

8 Hours

Teaching-Learning Process : Chalk and Board, Power Point Presentation.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing

Module-5

Non-Destructive Testing of Materials and Electrical Apparatus

Power frequency measurements- Schering bridge for audio frequency, transformer ratio arm bridge. Partial discharge measurements- straight discharge detection, Balance detection.

High Voltage Testing of Electrical Apparatus-Testing of insulators, bushings, circuit breakers, cables. Testing of transformers- Impulse test, Tests on surge arrestors. **8 Hours**

Teaching-Learning Process : Chalk and Board, Power Point Presentation.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding

List of Text Books

1. High Voltage Engineering, M.S. Naidu, V. Kamaraju, McGraw Hill, 5th Edition, 2013

List of Reference Books

1. High Voltage Engineering Fundamentals, E. Kuffel, W.S. Zaengl, J. Kuffel, Newnes, 2nd Edition, 2000
2. High Voltage Engineering, Wadhwa C.L., New Age International, 3 rd Edition, 2012.
3. High-Voltage Test and Measuring Techniques, Wolfgang Hauschild • Eberhard Lemke, Springer, 1st Edition 2014.
4. High Voltage Engineering, Farouk A.M. Rizk, CRC Press, 1st Edition 2014.

List of URLs, Text Books, Notes, Multimedia Content, etc

1. http://electrical-engineering-portal.com
2. http://nptel.ac.in/courses/108104048/
3. Fundamentals of High Voltage Engineering By S.K.Singh, Dhanpat Rai& Co.

Course Outcomes	**At the end of the course, the student will be able to:** **CO-1: Interpret** the conduction and breakdown phenomenon in dielectrics. **(L2)** **CO-2: Apply** the basic principles for generation of high voltage, currents and Impulse voltages. **(L3)** **CO-3: Apply** measurement techniques for High Voltage, current and Impulse voltages. **(L3)** **CO-4: Summarize** the overvoltage phenomenon and protection of electric power systems. **(L2)** **CO-5: Explain** non-destructive testing of materials and high-voltage testing of electric apparatus. **(L2)**

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Engineers and Society and Life-Long Learning.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Department of Electrical and Electronics Engineering

Question paper pattern:
The question paper will have ten questions. Each question is set for 20 marks.
There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
The students have to answer 5 full questions, selecting one full question from each module.

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Course Code:	BEE515A	TITLE: High Voltage Engineering					Faculty Name:		Mr. Raghavendra L		
List of Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	-	-	-	2	-	-	-	-	-	2
CO-2	2	2	-	-	-	2	-	-	-	-	-	2
CO-3	2	2	-	-	-	2	-	-	-	-	-	2
CO-4	2	2	-	-	-	2	-	-	-	-	-	2
CO-5	2	2	-	-	-	2	-	-	-	-	-	2

Note: 3= Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Course Code: BEE515A	TITLE: High Voltage Engineering	Faculty Name: Mr. Raghavendra L
List of Course Outcomes	Program Specific Outcome	
	PSO1	PSO2
CO-1	2	-
CO-2	2	-
CO-3	2	-
CO-4	2	-
CO-5	2	-

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution "-"= No Contribution