



SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203



DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



VII SEMESTER
EE3761- HIGH VOLTAGE ENGINEERING

Regulation – 2023

Academic Year 2026–2027 (odd)

Prepared by

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SUBJECT: EE3761- HIGH VOLTAGE ENGINEERING

SEM / YEAR: VII / IV

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UNIT I - OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS				
SYLLABUS: Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over Voltages-Insulation Coordination.				
PART-A				
Q.No	Questions	BT Level	Competence	COs
1.	Why high voltage is preferred for transmission of long distance?	1	Remember	CO1
2.	List the sources of switching over voltages in power system	1	Remember	CO1
3.	Define lightning phenomenon	1	Remember	CO1
4.	Define Isokeraunic level and back flash over	2	Understand	CO1
5.	List out various schemes of protection against over voltages	2	Apply	CO1
6.	Define Shielding angle.	2	Understand	CO1
7.	List the techniques to be adopted for controlling switching over voltages?	2	Evaluate	CO1
8.	Infer the concept of switching surge? Mention its approximate magnitude and frequency.	1	Apply	CO1
9.	What is the use of valve type lightening arrester?	1	Apply	CO1
10.	Draw the mathematical model of lightning.	1	Remember	CO1
11.	State the specifications of a travelling wave?	3	Analyze	CO1
12.	Define surge impedance of a line?	3	Remember	CO1
13.	Define corona inception voltage.	3	Analyze	CO1
14.	Define attenuation? How they are caused?	4	Analyze	CO1
15.	List the origin of switching surges?	4	Evaluate	CO1
16.	List the causes of power frequency over voltages in power system?	4	Understand	CO1
17.	Mention the specifications of the standard impulse voltage?	6	Create	CO1
18.	Express the equations for reflection coefficient and refraction co- efficient of voltage and current waves.	5	Understand	CO1
19.	Draw the typical wave shape of switching surges.	5	Create	CO1
20.	Explain are the use of protective devices.	6	Remember	CO1
21.	Mention the breakdown strength of air at STP Condition, and also the STP Value.	1	Remember	CO1
22.	What is Pilot Steamer and stepped leader? Mention its Specifications.	1	Remember	CO1

23.	List the causes of power frequency over voltages in power system.	3	Analyze	CO1
24.	Define effectively or solidly grounded system.	2	Understand	CO1
PART-B				
1.	(i) Explain the technique of modeling the lightning. (8) (ii) Discuss in detail the characteristics of switching surges with necessary waveforms. (8)	2	Evaluate	CO1
2.	Explain the different theories of charge formation in the cloud. (16)	3	Apply	CO1
3.	Explain in detail the protection of power system equipment's using protective devices. (16)	1	Evaluate	CO1
4.	Explain various causes of power frequency over voltages in power systems and its control techniques. (16)	1	Remember	CO1
5.	Derive the expression for velocity of travelling waves on transmission line. (16)	3	Remember	CO1
6.	Draw & Explain the Bewley Lattice Diagram for a two substations system. (16)	2	Understand	CO1
7.	Explain the control measures for over voltage due to Switching surge and lightning over voltages. (16)	2	Analyze	CO1
8.	Give the origin and characteristics of switching surges and explain the causes of over voltage due to switching surges in EHV and UHV system. (16)	4	Understand	CO1
9.	What are the causes for switching and power frequency over voltages? How are they Controlled in power systems? (16)	4	Apply	CO1
10.	Write short notes on: (a) Rod gaps used as protective devices (b) Ground wires for protection of overhead lines. (16)	1	Remember	CO1
11.	Discuss elaborately various sources of Temporary over voltages. (16)	1	Remember	CO1
12.	Briefly explain about Corona loss and its effects related to Transmission system. (16)	4	Analyze	CO1
13.	Develop wave equation of travelling waves in transmission line and also discuss the behavior of travelling waves in open circuited transmission. (16)	4	Analyze	CO1
14.	(i) Draw the cross sectional view of a valve type Lightning arrester and explain its Operation with V-I characteristics (8) (ii) Give the requirements of ground wire for protecting power conductors against Lightning stroke. Explain how they are achieved in practice (8)	5	Analyze	CO1
15.	Discuss the behavior of traveling waves in open circuited and short circuited transmission line.	4	Apply	CO1
16.	A surge of 15 kV magnitude travels along a cable towards its junction with an overhead line. The inductance and capacitance of the cable and overhead line are respectively 0.3 mH, 0.4 μ F and 1.5 mH, 0.012 μ F per km. Evaluate the voltage rise at the junction due to the surge.	5	Evaluating	CO1
17.	Develop the expression for reflection and refraction	6	Creating	CO1

	coefficients for voltage and current waves when the transmission line of surge impedance Z terminated with a resistance of R ohm.			
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UNIT II – DIELECTRIC BREAKDOWN				
SYLLABUS: Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields –Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.				
PART-A				
Q.No	Questions	BT Level	Competence	Cos
1.	List the properties of dielectric materials.	2	Remember	CO2
2.	Discuss about ionization by collision	2	Remember	CO2
3.	Write the Paschen’s law	2	Remember	CO2
4.	What are electronegative gases?	1	Remember	CO2
5.	Outline the concept of corona discharge	1	Remember	CO2
6.	Define intrinsic strength?	1	Understand	CO2
7.	Give the criterion for breakdown in non-uniform fields?	2	Apply	CO2
8.	Discuss about composite dielectric? List its properties?	1	Analyze	CO2
9.	Define Townsends first ionization coefficient	1	Understand	CO2
10.	Define uniform and non-uniform fields.	1	Understand	CO2
11.	Electron attaching gases useful for practical use as insulants when Compared to non-attaching gases-justify?	3	Remember	CO2
12.	What are pure liquid di-electrics?	3	Understand	CO2
13.	Give the usual range of vacuum used in high voltage apparatus?	3	Remember	CO2
14.	Commercial liquid dielectrics are different from pure liquid Dielectrics? Justify	4	Create	CO2
15.	List the factors that influence conduction in pure liquid dielectrics	4	Evaluate	CO2
16.	Outline concept of “stressed oil volume theory”?	4	Evaluate	CO2
17.	Give the Concept of time lag in breakdown of dielectrics?	6	Analyze	CO2
18.	List out various quantities of transformer oil.	5	Analyze	CO2
19.	State the factors which affect breakdown of gaseous dielectrics	5	Understand	CO2
20.	Explore the concept of penning effect	6	Create	CO2
21.	List the various dielectric materials used in power system.	1	Remember	CO2
22.	Write down the properties of gas insulators	1	Remember	CO2
23.	Draw the breakdown characteristics of SF_6 and N_2 as a function of pressure.	2	Apply	CO2
24.	Give the Applications of vacuum insulators.	2	Apply	CO2
PART-B				
1.	Explain the Townsend’s first and second ionization	1	Remember	CO2

	processes.(16)			
2.	Explain in detail the breakdown mechanism in non-uniform fields and phenomenon of corona (16)	1	Remember	CO2
3.	Explain the phenomenon of corona discharge and breakdown Mechanism in non-uniform fields. (16)	1	Remember	CO2
4.	(i) Briefly explain about Corona loss and its effects related to Transmission system. (8) (ii) Explain various mechanisms of Vacuum breakdown (8)	2	Apply	CO2
5.	Explain the various theories that explain breakdown in pure and Commercial liquid dielectrics. (16)	3	Remember	CO2
6.	Explain the phenomena of electrical conduction in liquids. How does it differ from that in gases? (16)	2	Understand	CO2
7.	Explore “stressed oil volume theory”, and how does it explain breakdown in large volumes of commercial liquid dielectrics(16)	2	Understand	CO2
8.	Explain the difference between photo-ionization and photo- electric emission. (16)	2	Analyze	CO2
9.	(i) Derive the criterion for breakdown in electronegative gases. (8) (ii) Explain the Streamer theory of breakdown in air at atmospheric pressure. (8)	4	Analyze	CO2
10.	(i) Outline concept of anode and the cathode streamers? Explain the mechanism of their formation and development leading to breakdown (8) (ii) Describe the current growth phenomenon in a gas subjected to uniform electric fields. (8)	1	Analyze	CO2
11.	Explain about the breakdown mechanisms in solid dielectrics with neat sketches (16)	1	Analyze	CO2
12.	Explain thermal breakdown mechanisms in solid dielectrics. Derive an expression for critical thermal breakdown voltage (V_c) and critical electric field (E_c) for the same. State clearly the assumptions made(16)	1	Apply	CO2
13.	Explain the dielectrics characteristics of liquid dielectrics and also explain the liquid purification system(16)	5	Create	CO2
14.	Give short notes on the application of dielectric materials for (i) Transformers (8) (ii) Circuit Breakers.(8)	4	Evaluate	CO2
15.	Explain the following breakdown mechanism in vacuum. (i) Particle Exchange Mechanism. (8) (ii) Anode and cathode heating Field emission. (8)	2	Analyze	CO2
16.	Explain the various processes followed for the maintenance of transformer oil quality. (16)	4	Evaluate	CO2
17.	Give a short note on the electromechanical and thermal breakdown mechanism in solid dielectric. (16)	5	Analyze	CO2

UNIT III - GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS

SYLLABUS: Generation of High DC, AC, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators, Measurement of High voltages, and High currents.

High Resistance with series ammeter – Dividers - Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shunts, Digital techniques in high voltage measurement.

PART-A

Q.No	Questions	BT Level	Competence	COs
1	Give the expression for effective inductance of distributed inductors in impulse current generator	1	Create	CO3
2	What are the specifications for standard impulse voltage	1	Arrange	CO3
3	Write the different forms of high voltages required for the testing of electrical apparatus	3	Analyze	CO3
4	List the merits and demerits of Van de Graff generator?	3	Remember	CO3
5	Draw the voltage multiplier circuit.	3	Apply	CO3
6	Define the standard switching impulse voltage.	4	Remember	CO3
7	What is tesla coil?	1	Remember	CO3
8	Give the basic principle of electrostatic generator?	1	Understand	CO3
9	Draw the circuit for producing impulse voltage.	4	Understand	CO3
10	Draw Schematic diagram of Marx circuit arrangement for multistage impulse generator.	4	Remember	CO3
11	State the components of multistage impulse generator?	5	Apply	CO3
12	Draw a typical impulse current wave form.	2	Remember	CO3
13	What is Rogowski coil? Give its limitations?	5	Remember	CO3
14	Enumerate the reason for using sphere type electrodes in HV measurement	2	Analyze	CO3
15	Write the advantages and disadvantages of CVT.	6	Understand	CO3
16	How is stray effect reduced in resistive type of shunt measurements?	6	Understand	CO3
17	What are the drawbacks of resistance potential divider?	1	Evaluate	CO3
18	Give the basic principle of generating and electrostatic voltmeter?	2	Evaluate	CO3
19	List out various digital techniques in high voltage measurement.	2	Apply	CO3
20	Give short notes on the effect of nearby earthed objects on the measurements using sphere gaps?	1	Create	CO3
21	Mention some advantages of Faraday generator.	2	Apply	CO3
22	List the general methods used for measurement of high frequency and impulse currents	1	Understand	CO3
23	Why is peak value instrument needed in high voltage measurement?	2	Analyze	CO3
24	State the type of measuring devices preferred for measurement of high frequency impulse current.	5	Analyze	CO3

PART-B

1	(i)Write a brief note on resonant transformer (8) (ii) How is impulse current generated using capacitor bank? Explain it in detail.(8)	1	Analyze	CO3
2	Explain simple voltage doubler and cascaded voltage doubler used for generation of high DC voltages.(16)	2	Apply	CO3
3	What is the principle behind the electrostatic energy conversion methods? Explain the construction and operation of Van de Graaff generator.(16)	1	Analyze	CO3
4	With a neat sketch explain the Cockcroft – Walton voltage multiplier circuit for generation of high DC voltages. (16)	1	Remember	CO3
5	Explain with diagrams, different types of rectifier circuits for producing high D.C. voltages. (16)	2	Understand	CO3
6	Discuss elaborately the principle and operation of Cascaded transformers for generating high AC voltages. (16)	2	Understand	CO3
7	Discuss elaborately the principle and operation of impulse current generator(16)	2	Understand	CO3
8	Give different circuits that produce impulse waves explaining clearly their relative merits and demerits. (16)	3	Analyze	CO3
9	With a neat circuit and phasor diagram, explain the Capacitance Voltage Transformer(16)	2	Understand	CO3
10	List the various techniques used for measurement of Dc voltages and Explain (i) Generating Voltmeter. (5) (ii) Resistance potential divider (5) (iii) Series resistance (6)	6	Evaluate	CO3
11	Tabulate and explain the methods used for measurement of High Voltages. (16)	4	Remember	CO3
12	Explain briefly the Electrostatic Voltmeter. Also list the advantages and disadvantages(16)	5	Remember	CO3
13	Explain the peak reading AC voltmeter? (16)	4	Analyze	CO3
14	(i)Explain the Hall generator for measuring high dc current.(8) (ii)Explain the measurement of high power frequency alternating current using CT with electro optical signal converter.(8)	4	Remember	CO3
15	With a neat diagram explain the sphere gap arrangement method of high A.C voltage measurement in detail and give the factors influencing the measurements. (16)	2	Understand	CO3
16	Describe in detail about the high current shunts in detail. (16)	4	Analyze	CO3
17	A generating voltmeter has to be designed so that it can have a range from 25 to 250 kV dc. If the indicating meter reads a minimum current of $2.5\mu\text{A}$ and maximum current of $30\mu\text{A}$, what should the capacitance of the generating voltmeter be? (16)	4	Analyze	CO3

UNIT IV - HIGH VOLTAGE TESTING & INSULATION COORDINATION				
SYLLABUS: High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators, and transformers - Insulation Coordination.				
PART-A				
Q.No	Questions	BT Level	Competence	Cos
1.	What is the difference between type and routine test?	2	Remember	CO5
2.	State the importance of insulation coordination in Power system	1	Remember	CO5
3.	Define 50% and 100% flashover voltage?	1	Analyze	CO5
4.	Define creepage distance?	1	Remember	CO5
5.	Enumerate the difference between type and routine tests?	1	Understand	CO5
6.	Define air density correction factor	2	Apply	CO5
7.	Discuss about BIL in power system insulation coordination?	2	Remember	CO5
8.	List the tests to be carried out on insulator and give a brief account of each test?	2	Apply	CO5
9.	Infer the significance of power factor tests?	3	Analyze	CO5
10	List out the standards for testing bushing, CB, insulators and transformer	4	Understand	CO5
11	List out tests conducted on power transformer as per standard	4	Create	CO5
12	State the various test conducted on bushing	3	Understand	CO5
13	Define impulse voltage and withstand voltage	3		CO5
14	List out various tests to be carried out on circuit breaker	1	Understand	CO5
15	Give the values of reference atmospheric condition as per I.S specifications	1	Apply	CO5
16	Outline the demerits of synthetic testing of circuit breaker	4	Evaluate	CO5
17	Explore the concept of insulation coordination	5	Remember	CO5
18	Examine the concept of one minute dry/wet withstand test	6	Analyze	CO5
19	How is impulse voltage withstand test conducted	5	Understand	CO5
20	Distinguish between flashover and puncture	6	Analyze	CO5
21	Define the disruptive discharge voltage.	2	Apply	CO5
22	Draw the volt time characteristics for good insulation coordination.	5	Analyze	CO5
23	Define front and tail time in impulse wave.	2	Apply	CO5
24	List the tests conducted on surge arresters.	2	Apply	CO5
PART-B				
1.	Explain the following: (i) Flashover voltage. (4) (ii) Withstand voltage. (5) (iii) Impulse voltage. (5) (iv) Creepage distance. (2)	1	Remember	CO5

2.	Discuss the different high voltage tests conducted on bushings. (16)	3	Remember	CO5
3.	What are the tests conducted on isolators and circuit breakers? Explain in detail. (16)	3	Understand	CO5
4.	Explain the different aspects of insulation design and insulation coordination adopted for EHV systems. (16)	4	Apply	CO5
5.	Explain the methods of impulse testing of high voltage transformers. List are the procedure adopted for locating the failure. (16)	4	Understand	CO5
6.	Explain in detail the power frequency and impulse voltage test need to be conducted on bushings with necessary diagrams (16)	4	Remember	CO5
7.	Explain the following terms used in HV testing as per the standards (i) Disruptive discharge voltage. (4) (ii) Creepage distance. (4) (iii) Impulse voltage. (4) (iv) 100% and 50 % flash over voltage. (4)	4	Remember	CO5
8.	Briefly discuss the various tests carried out the insulator. (16)	2	Understand	CO5
9.	Discuss in detail the dielectric power factor test and partial discharge test procedures for HV cables. (16)	2	Apply	CO5
10.	Give the necessity of volt-time curves? Explain the procedure for constructing Volt-time curves with neat sketch. Give its significance in power system studies. (16)	1	Analyze	CO5
11.	Discuss elaborately about Insulation coordination. (16)	1	Analyze	CO5
12.	Briefly explain short circuit plant pertaining to testing of CB. (16)	1	Analyze	CO5
13.	(i) Elaborately discuss about various types of standards for HV power apparatus testing of electrical power apparatus. (8) (ii) Write short notes on statistical methods for insulation Coordination. (8)	5	Create	CO5
14.	(i) Briefly explain about pollution testing of Insulators. (8) (ii) Draw the layout for synthetic testing and explain the procedure. (8)	6	Evaluate	CO5
15.	List the different test conducted on cables according to standards. Explain any one of them. (16)	2	Apply	CO5
16.	Discuss the various tests carried out in a circuit breaker at high voltage laboratories. (16)	6	Evaluate	CO5
17.	Describe the various Indian and international standard specification for high voltage testing of electrical power apparatus. (16)	6	Evaluate	CO5

UNIT V				
SYLLABUS: APPLICATION IN INDUSTRY				
Introduction – electrostatic applications- electrostatic precipitation, separation, painting/coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.				
PART-A				
Q.No	Questions	BT Level	Competence	Cos
1.	Define electrostatic precipitation	2	Remember	CO5
2.	State the principle of electrostatic separation.	1	Remember	CO5
3.	What is electrostatic painting?	1	Analyze	CO5
4.	Mention two advantages of electrostatic coating	1	Remember	CO5
5.	Define electrostatic spraying	1	Understand	CO5
6.	What is electrostatic imaging?	2	Apply	CO5
7.	State the principle used in xerographic printing.	2	Remember	CO5
8.	Mention two applications of electrostatic printing	2	Apply	CO5
9.	What is meant by electrostatic transport of materials?	3	Analyze	CO5
10	Explain the role of electrostatic forces in material handling.	4	Understand	CO5
11	How is electrostatic charging used in the manufacture of sandpaper?	4	Create	CO5
12	What is the purpose of electrostatic attraction in sandpaper manufacturing?	3	Understand	CO5
13	Define a smoke particle detector.	3		CO5
14	State the working principle of an ionization smoke detector.	1	Understand	CO5
15	What is electrostatic spinning (electrospinning)?	1	Apply	CO5
16	Mention two applications of electrospun nanofibers	4	Evaluate	CO5
17	Define electrostatic pumping	5	Remember	CO5
18	What is electrostatic propulsion?	6	Analyze	CO5
19	Mention one application of electrostatic propulsion in space technology.	5	Understand	CO5
20	Define ozone generation using high voltage.	6	Analyze	CO5
21	Why is ozone generated using corona discharge?	2	Apply	CO5
22	List any two biomedical applications of high voltage engineering.	5	Analyze	CO5
23	What is electroporation in biomedical applications?	2	Apply	CO5
24	State the importance of high voltage in medical sterilization processes.	2	Apply	CO5
PART-B				
1.	Explain the principle, construction, working, advantages, and industrial applications of electrostatic precipitators with neat diagrams.	1	Remember	CO5
2.	Discuss the working principle of electrostatic separation and explain its applications in mineral processing, recycling, and waste management	3	Remember	CO5
3.	Describe the electrostatic painting and coating process in detail.	3	Understand	CO5

4.	Explain the principle and operation of electrostatic spraying systems used in agriculture and industrial applications.	4	Apply	CO5
5.	Elaborate on electrostatic imaging and printing techniques. Explain the working of xerography with a suitable block diagram	4	Understand	CO5
6.	Discuss the various methods of electrostatic transport of materials. Explain how electrostatic forces are utilized for handling powders and particulate materials in industries	4	Remember	CO5
7.	Explain the manufacturing process of sandpaper using electrostatic techniques. Discuss the importance of particle orientation and its effect on product quality.	4	Remember	CO5
8.	Describe the construction and working of smoke particle detectors.	2	Understand	CO5
9.	Explain the principle, setup, and applications of electrospinning	2	Apply	CO5
10.	Discuss electrostatic pumping and electrostatic propulsion systems in detail.	1	Analyze	CO5
11.	Explain the mechanism of ozone generation using high-voltage corona discharge	1	Analyze	CO5
12.	Write short notes on the following: (a) Electrostatic Painting (8) (b) Electrostatic Spraying (8)	1	Analyze	CO5
13.	Write short notes on the following: (a) Electrostatic Precipitation (8) (b) Electrostatic Separation (8)	5	Create	CO5
14.	Write detailed notes on the following: (a) Electrostatic Imaging and Printing (b) Transport of Materials (c) Manufacture of Sandpaper	6	Evaluate	CO5
15.	Briefly explain about applications of High Voltage Engineering in a) Ozone Generation (8) b) Biomedical Applications (8)	2	Apply	CO5
16.	Explain the construction, operation, and performance characteristics of an Electrostatic Precipitator. Discuss the factors affecting collection efficiency and methods to improve its performance.	6	Evaluate	CO5
17.	"High Voltage Engineering plays a vital role in modern industrial and biomedical applications." Justify this statement by discussing the applications of high voltage in Electrostatic Printing and Imaging, Smoke Particle Detection, Ozone Generation, Electrospinning, Biomedical Engineering, Electrostatic Propulsion	6	Evaluate	CO5

Course Outcomes:

COs	Course Outcome
CO1	To understand the various types of over voltages in power system and protection methods.
CO2	To know about nature of Breakdown mechanism in solid, liquid and gaseous dielectrics
CO3	To know about Generation & Measurement of over voltages in laboratories.
CO4	To understand the testing of power apparatus and insulation coordination.
CO5	To understand of applications of HV in industry.

