

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER- VII EXAMINATION – SUMMER 2026****Subject Code:3170917****Date:29-05-2026****Subject Name:High Voltage Engineering****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) What voltage level is considered high voltage? Define the term 'insulation' in the context of high voltage electrical systems.	03
	(b) Discuss the working principle of a Van de Graff generator and its role in generating high voltages.	04
	(c) Discuss the significance of transformer oil filtration and testing in maintaining the reliability of power transformers. What role does transformer oil play in electrical insulation?	07
Q.2	(a) List the numerical methods used for analyzing electrical fields in high voltage equipment.	03
	(b) State Paschen's Law. How does the law relate the breakdown voltage to the product of pressure and electrode distance?	04
	(c) Describe Townsend's breakdown model in gases. Explain the key assumptions and principles underlying this model, including the role of ionization and electron multiplication.	07
	OR	
	(c) What is the Finite Element Method (FEM) and how is it used to solve partial differential equations? Explain the concept of 'elements' and 'nodes' in FEM.	07
Q.3	(a) What is the role of a surge diverter in high voltage systems?	03
	(b) Explain the concept of thermal breakdown in solid electrical insulators.	04
	(c) Explain the streamer mechanism of breakdown in gases. How does it differ from other breakdown mechanisms like the Townsend discharge?	07
	OR	
Q.3	(a) What is the purpose of Frequency Response Analysis (FRA) in evaluating machine windings?	03
	(b) A generating voltmeter has to be designed so that it can have range from 20 KV to 200 KV DC. If the indicating meters reads minimum current of 2 μ A. What should the capacitance of the generating voltmeter be? What should be the upper range of the meter? Assume that driving motor has synchronous speed of 1500 rpm.	04
	(c) Explain the principle behind the high voltage testing of insulators and bushings. How does this testing ensure the reliability of these components in an electrical system?	07
Q.4	(a) What is the principle behind dielectric loss measurement in insulation testing, and why is it important?	03
	(b) What is tracking in solid dielectrics, and how does it lead to breakdown?	04
	(c) Describe the components and their roles in a multi-stage Marx circuit. Why are each of these components necessary for the circuit's operation?	07

OR

- Q.4** (a) A simple two-stage voltage multiplier circuit uses diodes and capacitors. If the input AC voltage to the first stage is 100 V (RMS) and the circuit operates at a frequency of 50 Hz, calculate the DC output voltage of the voltage multiplier. **03**
- (b) Explain the basic principle of partial-discharge (PD) measurements in electrical insulation systems. **04**
- (c) Describe the working principle of a spark gap in measuring peak voltages. What are the key factors that influence the spark gap's performance? **07**
- Q.5** (a) What are the front time and tail time in an impulse voltage? Sketch the standard lightning impulse waveform and label the front time and tail time. **03**
- (b) Describe the Chubb–Fortescue method for measuring peak high-voltage levels **04**
- (c) Describe the basic operation of a Cockcroft-Walton Multiplier. How does it generate high voltage from a lower input voltage? **07**

OR

- Q.5** (a) Explain how dissolved gas analysis (DGA) can be used to identify potential faults in a transformer. **03**
- (b) Explain the lightning mechanism and how it contributes to over voltages in electrical systems. **04**
- (c) Explain the concept of insulation coordination in high voltage systems. How does insulation coordination help in protecting electrical equipment from over voltages, and what factors are considered in determining the appropriate insulation levels? **07**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII EXAMINATION – SUMMER 2025

Subject Code:3170917

Date:16-05-2025

Subject Name:High Voltage Engineering

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Define Townsend's first ionization coefficients. Obtain current growth equation due to first ionization.	03
	(b) List advantages, disadvantages and applications of Van de Graff generator.	04
	(c) Explain High voltage Schering bridge for $\tan \delta$ and capacitance measurement of Insulators.	07
Q.2	(a) Define the terms: Statistical time lag, formative time lag, total time.	03
	(b) Explain treeing and tracking related to solid breakdown.	04
	(c) Draw and explain Marx circuit and modified Marx circuit of multistage impulse generator.	07
	OR	
	(c) List out the common test facilities available in High Voltage Lab.	07
Q.3	(a) Explain equivalent circuit of partial discharge.	03
	(b) What is Finite Element Method? Brief it for solving the field problems.	04
	(c) Explain how a sphere gap can be used to measure the peak value of voltages. What are the parameters and factors that influence such voltage measurement?	07
	OR	
Q.3	(a) Why is the breakdown strength higher in electronegative gases than in other gases?	03
	(b) What are the commercial liquids? Explain purification test cell system related to liquids.	04
	(c) A 10 stage Cockcroft-Walton circuit has all capacitors of $0.06 \mu\text{F}$. The secondary voltage of the supply transformer is 100 KV at a frequency of 150Hz. If the load current is 1mA, determine: (1) percentage voltage regulation. (2) The ripple (c) The optimum number of stages for maximum output voltage.	07
Q.4	(a) Explain high voltage test on Insulator.	03
	(b) Discuss the different methods of measuring high D.C. Voltages. What are the limitations.	04
	(c) What is Paschen's Law? How do you account for the minimum voltage for breakdown under a given 'p x d' condition?	07
	OR	
Q.4	(a) Discuss Hall effect in Hall generator.	03
	(b) Explain Tesla coil with its circuit & Waveform.	04
	(c) What is meant by insulation co-ordination? How are the protective devices chosen for optimal insulation level in a power system?	07

- Q.5** (a) What is surge arrester? Explain it's importance in power system. **03**
(b) Explain with neat diagram the principle & construction of an electrostatic voltmeter. **04**
(c) Explain corona discharge. What are different factor affecting Corona losses? How Corona loss can be eliminated? **07**

OR

- Q.5** (a) Discuss power frequency tests of insulator. **03**
(b) Discuss the method of balanced detection for locating partial discharges in electrical equipments. **04**
(c) A 12 stage impulse generator has $0.126\mu\text{F}$ capacitors. The wave front and wave tail resistances connected are 800Ω and 5000Ω respectively. If the load capacitor is 1000pF , find the front and tail times of the impulse wave produced. **07**

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2024****Subject Code:3170917****Date:22-05-2024****Subject Name:High Voltage Engineering****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	(a) Explain partial discharge.	03
	(b) Give comparison between uniform and non-uniform Field.	04
	(c) Explain High voltage Schering bridge for $\tan\delta$ and capacitance measurement of Insulators.	07
Q.2	(a) Discuss power frequency tests of insulator.	03
	(b) How are switching impulse generated in Laboratory, Explain in brief.	04
	(c) Explain with neat diagram the principle & construction of an electrostatic voltmeter.	07
	OR	
	(c) Define Townsend's first and second ionization coefficients. Obtain Current growth equation due to first and second ionization.	07
Q.3	(a) Explain Sweep Frequency Response Analysis (SFRA).	03
	(b) Explain Finite Element Method (FEM).	04
	(c) Draw symbolic Construction of Van-De-Graff generator and explain its working. Also mention its applications with merits and demerits.	07
	OR	
Q.3	(a) Discuss Hall effect in Hall generator.	03
	(b) How Potential Divider method used for measurement of high voltage DC with its limitations.	04
	(c) Differentiate between Marx & modified Marx circuit for multistage impulse generators with circuit.	07
Q.4	(a) Explain front and tail times of an impulse wave with neat sketch.	03
	(b) Explain breakdown test for Transformer oil.	04
	(c) Explain Voltage Multiplier Circuit for generation of High Voltage.	07
	OR	
Q.4	(a) List out the common test facilities available in High Voltage Lab.	03
	(b) Discuss factors affecting breakdown of gases.	04
	(c) What is meant by insulation co-ordination? How are the protective devices chosen for optimal insulation level in power system?	07
Q.5	(a) What is surge arrester? Explain in brief.	03
	(b) Explain Tesla coil with its circuit & Waveform.	04
	(c) Explain corona discharge. What are different factor affecting Corona losses? How Corona loss can be eliminated?	07
	OR	
Q.5	(a) Explain high voltage test on Insulator.	03
	(b) List out the causes of overvoltage in power voltage.	04
	(c) Explain working of sphere gap and also explain factor influence such a voltage measurement.	07

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- VII EXAMINATION-SUMMER 2023****Subject Code: 3170917****Date: 26/06/2023****Subject Name: High Voltage Engineering****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) What is time-lag? Discuss its components	03
	(b) Discuss the factors which affects the components of time lag.	04
	(c) What is Finite Element Method for evaluation of field distribution? Discuss the procedure associated with this method and discuss its advantages and limitations.	07
Q.2	(a) Define Townsend's first and second ionization coefficients	03
	(b) Explain the Townsends criterion for a spark.	04
	(c) Discuss various criteria suggested by researchers for transition from avalanche to streamer.	07
OR		
Q.2	(c) State and explain Paschen's law. Derive expression for $(pd)_{min}$ and $V_{b_{min}}$. Assume $A = 12$, $B = 365$ and $\gamma = 0.02$ for air. Determine $(pd)_{min}$ and $V_{b_{min}}$.	07
Q.3	(a) Discuss its advantages and disadvantages of series parallel resonant circuit.	03
	(b) Compare the performance of half wave rectifier and voltage doubler circuits for generation of high d.c. voltages.	04
	(c) Explain with neat sketches Cockroft-Walton voltage multiplier circuit. Explain clearly its operation when the circuit is (i) unloaded (ii) loaded.	07
OR		
Q.3	(a) Define the terms (i) Impulse voltages; (ii) Chopped wave; (iii) Impulse flash over voltage	03
	(b) Draw two simplified impulse generator circuits.	04
	(c) Describe the construction, principle of operation and application of a multistage Marx's Surge Generator	07
Q.4	(a) What are the requirements of a sphere gap for measurement of high voltages?	03
	(b) Discuss the disadvantages of sphere gap for measurements of high voltages.	04
	(c) Explain with neat diagram how rod gaps can be used for measurement of high voltages. Compare its performance with a sphere gap.	07
OR		
Q.4	(a) Draw a simplified equivalent circuit of a resistance potential divider.	03
	(b) What are the problems associated with measurement of very high impulse voltages?	04
	(c) Discuss and compare the performance of (i) resistance (ii) capacitance potential dividers for measurement of impulse voltages.	07

- Q.5 (a)** What are partial discharges? Differentiate between internal and external discharges. **03**
- (b)** Write a short note on the cable sample preparation before it is subjected to various tests. **04**
- (c)** Describe various tests to be carried out on a circuit breaker. **07**
- OR**
- Q.5 (a)** Explain clearly how the rating of a lightning arrester is selected. **03**
- (b)** What are BILS? Explain their significance in power system studies. **04**
- (c)** Draw a neat diagram of high voltage Schering bridge and analyse it for balanced condition. Draw its phasor diagram. Assume (i) Series equivalent (ii) Parallel equivalent representation of the insulating material. **07**
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GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2022****Subject Code:3170917****Date:08/06/2022****Subject Name:High Voltage Engineering****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) Which gases are generally observed while performing dissolved gas analysis of transformer oil?	03
	(b) Draw and explore the Duval's triangle	04
	(c) What is the present-day technique to monitor the mechanical integrity of big size power transformer? Discuss in detail.	07
Q.2	(a) Sketch the graph for Breakdown voltage-PD curve for gaseous insulating media with proper indications and nomenclature on X and Y axis	03
	(b) What will be standard breakdown strength of air for small gaps (1 mm) and large gaps (20 cm) under uniform field conditions and standard atmospheric conditions?	04
	(c) Compare the breakdown mechanisms (Townsend's & Streamer Theory) for gaseous insulating medium	07
	OR	
	(c) Explain any one numerical technique in detail with relevant equations (Charge simulation, Finite element, Finite difference, or Boundary element)	07
Q.3	(a) Enlist the breakdown mechanisms for solid dielectric	03
	(b) What is thermal breakdown in solid dielectric?	04
	(c) How is the purification and breakdown test of liquid dielectric carried out?	07
	OR	
Q.3	(a) A cascade transformer has four stages. What should be the power rating of the first (bottom most) transformer if the power rating of the last (Topmost) transformer is 'P'.	03
	(b) Find out advantages and disadvantages of Resonant transformer	04
	(c) Elucidate a generator which converts mechanical energy into electrostatic energy with relevant sketches? How is such generator fitted in laboratory?	07
Q.4	(a) Enlist the techniques (at least three for each) for HVAC and HVDC generation	03
	(b) Compare high voltage testing transformer with power transformer	04
	(c) Sketch and explain Cockcroft Walton circuit for five stage (200 kV × 5 = 1000 kV) high voltage DC generation.	07

OR

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| Q.4 | (a) | Represent the Chhub and Fortescue circuit | 03 |
| | (b) | Enlist a table for High voltage measurement techniques for DC Voltages, AC voltages (Power frequency) and Impulse voltages | 04 |
| | (c) | Sketch and explore generating voltmeter in detail | 07 |
| Q.5 | (a) | What is the function of lightning arrester and how it serves the purpose? | 03 |
| | (b) | What are the components of lightning strike? Give a sketch of it. | 04 |
| | (c) | What is meant by insulation co-ordination? How are the protective devices chosen for optimal insulation level in a power system? | 07 |
| OR | | | |
| Q.5 | (a) | How to measure radio interference? | 03 |
| | (b) | Enlist the high voltage test on cables. Describe any one in brief | 04 |
| | (c) | Enlist the high voltage tests to be performed on power transformer and explain any one in detail with relevant sketch | 07 |
