

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**
