

Seventh Semester B.E. Degree Examination, June-July 2009
High Voltage Engineering

3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions

- a. What are the advantages of transmitting electrical power at high voltage? Mention the industrial applications of high voltages. (07 Marks)
 - b. Define Townsend's first and second ionization coefficients. Derive from fundamentals the current growth equation and hence the Townsend's criterion for breakdown. (09 Marks)
 - c. In an experiment in a certain gas it was found that the steady state current is 5.5×10^{-3} A at 8 kV at a distance of 0.4cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1cm results in a current of 5.5×10^{-9} A. Calculate Townsend's primary ionization coefficient α . Neglect secondary ionization effects. (04 Marks)
- a. Briefly write about Paschen's law. (05 Marks)
 - b. Explain the electromechanical breakdown and thermal breakdown of solid dielectrics. (10 Marks)
 - c. Explain briefly suspended particle theory of breakdown in liquid dielectrics. (05 Marks)
- a. Explain with a neat diagram a three stage cascade transformer connection for producing high a.c voltages. (08 Marks)
 - b. A Cockcroft-Walton type voltage multiplier has eight stages with capacitances, all equal to $0.05\mu\text{F}$. The supply transformer secondary voltage is 125 kV (peak) at a frequency of 150Hz. If the load current to be supplied is 5mA, find
 - i) The percentage ripple
 - ii) The regulation and
 - iii) The optimum number of stages to obtain maximum output voltage. (08 Marks)
 - c. What are the advantages of series resonant circuit for producing high a.c voltages? (04 Marks)
- a. Explain how high impulse voltages are generated in a laboratory using Marx circuit. (08 Marks)
 - b. An 8-stage impulse voltage generator has $0.12 \mu\text{F}$ capacitors rated for 167kV. What is its maximum discharge energy? If it has to produce a $1/50 \mu\text{s}$ waveform across a load capacitor of 15,000 pF, find the values of the wave front and wave tail resistances. (08 Marks)
 - c. Define a standard lightning impulse current wave. (04 Marks)
- a. Explain the method of tripping a multistage impulse generator using three electrode gap arrangement. (08 Marks)
 - b. Describe with a sketch the working of a generating voltmeter used to measure high d.c voltages. (08 Marks)
 - c. An absolute electrostatic voltmeter has a moveable circular plate 8cms in diameter. If the distance between the plates during a measurement is 4mm, and the applied voltage is 1 kV, calculate the force on the plate (Assume medium as having $\epsilon_r = 1$). (04 Marks)
- a. Explain the method of measuring impulse voltages using sphere gaps. Discuss the factors that influence such measurements. (10 Marks)
 - b. Write a short note on magnetic links. (05 Marks)
 - c. A generating voltmeter is required to measure voltage between 15kV to 250kV. If the indicating meter needs a minimum current of $2\mu\text{A}$ and maximum of $35 \mu\text{A}$, determine the capacitance of the generating voltmeter. Assume that the speed of driving synchronous motor is 1500 rpm. (05 Marks)

- 7 a. What are partial discharges? Explain with a neat diagram, the basic principle of pulse current measurement of partial discharges using straight detectors. (10 Marks)
- b. A 20kV, 50Hz Schering bridge has a standard capacitance of $106\mu\text{F}$. In a test on a bakelite sheet, balance was obtained with a capacitance of $0.35\mu\text{F}$ in parallel with a non-inductive resistance of 318 ohms, the non-inductive resistance in the remaining arm of the bridge being 130 ohms. Determine the equivalent
- Series resistance and capacitance and the power factor of the test specimen.
 - Parallel resistance and capacitance and the power factor of the test specimen. (10 Marks)
- 8 a. With a neat diagram explain the impulse testing of transformers. How are the faults detected and located? (10 Marks)
- b. Mention the different power frequency tests that are carried out in practice on HV insulators. Explain the procedure of conducting each of these tests. (10 Marks)