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Seventh Semester B.E. Degree Examination, Dec.2023/Jan.2024 High Voltage Engineering

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Mention the classification of liquid dielectric and explain any one. (04 Marks)
- b. Derive the expression for the current in the air gap that is $i = i_0 e^{\alpha d}$ considering Townsend's first ionization coefficient. (08 Marks)
- c. A solid dielectric specimen of dielectric constant of 4.0 shown in Fig. Q1(c) has an internal void of thickness 1mm. The specimen is 1cm thickness and is subjected to a voltage of 80kV (rms). If the void is filled with air and if the breakdown strength of air can be taken as 30 KV (peak)/cm, find the voltage at which an internal discharge can occur.

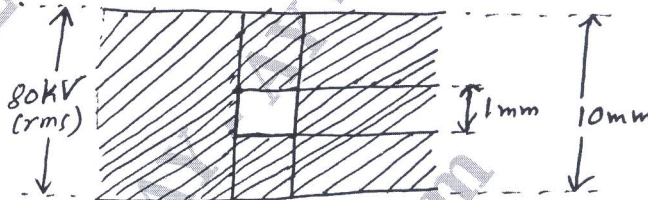


Fig Q1(c)

(08 Marks)

OR

- 2 a. What is meant by Time lag of breakdown? Explain Statistical and Formative time lag. (06 Marks)
- b. In an experiment in a certain gas it was found that the steady state current is 5.5×10^{-8} A at 8kV 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 . (06 Marks)
- c. Explain the mechanism of Streamer theory of breakdown in air occurs at atmospheric pressure with neat diagram. (08 Marks)

Module-2

- 3 a. What are the different forms of high voltage and mention their applications. (04 Marks)
- b. Explain the working of Cockcroft-Walton voltage multiplier circuit with schematic diagram. (08 Marks)
- c. With the help of a neat sketch, explain the construction and working principle of cascading of transformers of three units for producing very high AC voltage. (08 Marks)

OR

- 4 a. Explain the construction and working of a three-electrode gap tripping circuit used for the impulse generator. (08 Marks)
- b. With the help of a neat sketch, explain the working of impulse current generator circuit and its waveform. (08 Marks)

- c. A 100KVA, 400V/250KV testing transformer has 8% leakage reactance and 2% resistance on 100KVA base. A cable has to be tested at 500KV using the above transformer as a resonant transformer at 50Hz. If the charging current of the cable at 500KV is 0.4A, find the series inductance required. Assume 2% resistance for the inductor to be used and the connecting leads. Neglect dielectric loss of the cable. What will be the input voltage to the transformer? (04 Marks)

Module-3

- 5 a. Explain with schematic diagrams, construction and working principle of generating voltmeter. (08 Marks)
 b. Explain how peak value of high voltage AC is measured using Chubb – Frotescue method. (06 Marks)
 c. Discuss the factors affecting the measurement of high voltage using sphere gaps. (06 Marks)

OR

- 6 a. Explain the principle and construction of an electrostatic voltmeter for very high voltages. What are its merits and demerits for high voltage ac measurement? (12 Marks)
 b. What is Rogowski coil? Explain with a neat diagram its principle of operation for measurement of high impulse currents. (08 Marks)

Module-4

- 7 a. Explain the mathematical models for lightning discharges. (06 Marks)
 b. Explain the successive reflection lattice of a travelling wave. (06 Marks)
 c. Derive the expression for the voltage and current waves on long transmission lines and obtain the surge impedance of the line. (08 Marks)

OR

- 8 a. Explain the principle of insulation coordination in EHV and UHV systems. (10 Marks)
 b. Explain with suitable figures the principles and functioning of i) Expulsion gaps ii) Protector tubes. (10 Marks)

Module-5

- 9 a. With the help of a neat schematic diagram describe how dielectric loss and capacitance of an insulator can be measured using a high voltage Schering bridge. (08 Marks)
 b. Define partial discharge. Explain how it is measured using straight detection method. (06 Marks)
 c. Why are the earthing and Shielding arrangements needed in the Schering bridge measurements? (06 Marks)

OR

- 10 a. Describe the various electrical tests done on transformer. (08 Marks)
 b. What are the various power frequency and impulse tests done on insulator? Describe the procedure for impulse tests. (08 Marks)
 c. Write a short note on High voltage tests on cables. (04 Marks)
