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17EE73

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
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. Define Townsend's first and secondary ionization coefficients. Derive an expression for the current growth in a gas discharge due to secondary mechanism. **(08 Marks)**
   b. Explain the streams theory of breakdown in air at atmospheric pressure. **(08 Marks)**
   c. The following observations were made in an experiment for determination of dielectric strength of transformer oil. Determine the power law equation.

Gap spacing (cm)	4	6	8	10
Breakdown voltage (kv)	88	135	165	212

   (04 Marks)

OR

2 a. Describe bubble theory and thermal mechanism of breakdown in liquid dielectrics. **(08 Marks)**
   b. Classify the breakdown mechanism in solids and explain the electromechanical breakdown mechanism in solid dielectrics. **(08 Marks)**
   c. A steady current of $600\mu A$ flows through the plane electrode separated by a distance of 0.5cm when a voltage of 10kV is applied. Determine the Townsend's first Ionization coefficient if a current of $60\mu A$ flows when the distance of separation is reduced to 0.1cm and the field is kept constant at the previous value. **(04 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 the working principle of generating voltmeter with a neat sketch. **(06 Marks)**
b. Explain how peak value of high voltage AC is measured using Chubb-Fortescue method. **(06 Marks)**
c. Explain the factors influencing the sparkover voltage of sphere gaps. **(08 Marks)**

OR

6
a. Explain the schematic arrangement of an impulse potential divider with an oscilloscope connected for measuring impulse voltages. **(08 Marks)**
b. Explain with schematic diagrams how DC current can be measured using DC current transformers. **(06 Marks)**
c. A Rogowski coil is required to measure impulse current of 8KA having rate of change of current of 10^{10} A/sec. The voltmeter is connected across the integrating circuit which reads 8 volts for full scale deflection. The input to the integrating circuit is from the Rogowski coil. Determine the mutual inductance of coil and R and C of the integrating circuit. **(06 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. Explain the high voltage Schering bridge for the tan δ and capacitance measurement of insulators or bushings. **(10 Marks)**
b. What are partial discharges? Explain the methods of balanced detection for locating partial discharges in electrical equipment. **(10 Marks)**

OR

10
a. Explain the method of impulse testing of high voltage transformers. What is the procedure adopted for locating the failure? **(10 Marks)**
b. Explain with a schematic diagram, the synthetic testing procedure on valve units in HVDC systems. What are the different tests done using synthetic test circuit? **(10 Marks)**

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