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Fifth 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. Derive an expression for current in the air gap by considering Townsend's primary and secondary ionization coefficients. **(08 Marks)**
   b. Explain cavitation and bubble mechanism of breakdown in liquid dielectrics. **(06 Marks)**
   c. In an experiment in a certain gas it was found that the steady state current is 6×10^{-8}A at 10KV at a distance of 0.4cm between the plane electrodes keeping the filed constant and reducing the gap spacing to 0.2cm results in a current of 10×10^{-9}A. Calculate Townsend's primary ionization coefficient α. If the breakdown occurred when the gap distance was increased to 0.9cm, what is the value of Townsend's secondary ionization coefficient γ. **(06 Marks)**

OR

2 a. List the important insulating properties the liquid insulating medium must possess. **(06 Marks)**
   b. What are the limitations of Townsend theory and explain Streamer's theory. **(08 Marks)**
   c. Explain the mechanism of thermal breakdown in solid insulating materials. **(06 Marks)**

Module-2

3 a. With a neat circuit diagram, explain the three stage cascade transformer connection to produce high voltage. **(06 Marks)**
   b. A 100 KVA, 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. Determine the series inductance required and input voltage to the transformer. **(08 Marks)**
   c. Describe the working principle of Tesla coil and state its applications. **(06 Marks)**

OR

4 a. With a neat circuit diagram, explain the Marx circuit arrangement incorporating the series and wave tail resistances within the generator for impulse voltage generation. **(10 Marks)**
   b. What is trigatron gap? Explain its function and operation. **(06 Marks)**
   c. A 12 stage impulse generator has 0.126μF capacitors. The wave front and wave tail resistances connected are 800 ohms and 5000 ohms respectively. If the load capacitor is 1000pF, find the front and tail times of the impulse wave produced. **(04 Marks)**

Module-3

5. a. Discuss in brief the method of measuring HVAC by Chuub and Fortescue method. (06 Marks)

   b. Explain the method of measuring HVDC by series resistance micro ammeter and list its limitations. (08 Marks)

   c. A generating voltmeter is required to measure voltage between 20KV and 200KV. If the indication meter reads a minimum current of $2\mu A$ and a maximum of $25\mu A$, determine the capacitance f the generating voltmeter. Assume the speed of the driving synchronous motor is 1500rpm. (06 Marks)

OR

6. a. With a neat sketch, explain the construction and working principle of electrostatic voltmeter. List out the advantages. (10 Marks)

   b. Explain how and why a sphere gap is used for measurement of high voltage. Explain the various factors that affect the break-over voltage of sphere gap. (10 Marks)

Module-4

7. a. Explain the different theories of charge formation in clouds. (10 Marks)

   b. What are the different methods employed for lighting protection of over head lines? Explain them. (10 Marks)

OR

8. a. Explain the principles of insulation coordination on high voltage and extra high voltage power systems. How are the protective devices chosen for optimal insulation level in a power system? (10 Marks)

   b. Explain the different methods to control over voltages due to switching. (10 Marks)

Module-5

9. a. With a neat diagram, describe a high voltage Schering bridge to measure the capacitance and dissipation factor of a sample of dielectric. (08 Marks)

   b. Explain the transformer ratio arm bridge for audio frequency range measurements. (06 Marks)

   c. Discuss the method of discharge detection using straight detectors for locating partial discharges in electrical equipment. (06 Marks)

OR

10. a. Explain different methods of conducting short circuit tests on circuit breakers. (10 Marks)

    b. Name and explain in brief different tests that are carried out on high voltage insulators. (10 Marks)

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