CBCS SCHEME

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18EE56

Fifth Semester B.E. Degree Examination, July/August 2021
High Voltage Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. What is Paschen's law? How do you account for the minimum voltage for breakdown under a given "p × d" condition? **(06 Marks)**

b. Derive an expression for the current in the air gap that is $i = i_0 e^{\alpha d}$ considering Townsend's first ionization co-efficient. **(07 Marks)**

c. In an experiment in a certain gas it was found that the steady state current is 5.5×10^{-8} A at 8 KV at a distance of 0.4 cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1 cm results in a current of 5.5×10^{-9} A. Calculate Townsend's primary ionization coefficient α. **(07 Marks)**

2 a. Explain briefly Bubble theory of breakdown in liquid dielectrics. **(05 Marks)**

b. Explain suspended particle theory of breakdown in liquid dielectric. **(05 Marks)**

c. Explain the following breakdown mechanism in solid dielectrics,
(i) Electro Mechanical breakdown.
(ii) Thermal breakdown. **(10 Marks)**

3 a. Explain with a neat diagram and waveforms the voltage multiplier circuit using Cockcraft-Walton principle. **(07 Marks)**

b. A Cockcraft-Walton type voltage multiplier has 10 stages with capacitance all equal to 0.08 μF. The supply transforms secondary voltage is 115 KV at a frequency of 150 Hz. If the load current to be supplied is 10 mA, find:
(i) Average ripple.
(ii) The regulation.
(iii) The optimum number of capacitors for minimum regulation or voltage drop. **(08 Marks)**

c. Explain the necessary of using isolating transformers for excitation with cascade transformer units, if the power requirement is large? **(05 Marks)**

4 a. With neat sketch, explain the Mark's circuit arrangement for multistage impulse generator. **(07 Marks)**

b. Define the wave front and wave tail times of an impulse voltage wave. What are the percentage tolerances for a standard lighting impulse wave? **(06 Marks)**

c. Calculate the front and tail resistance for 5 stages. 1000 KV with capacitance of each stage is 5 μF and a load capacitance of 10000 pF for 1 μs front and 50 μs tail wave. **(07 Marks)**

5 a. Explain the working principle of generating voltmeter with a diagram. **(08 Marks)**

b. A generating voltmeter is required to measure voltage between 15 KV to 250 KV. If the indicating meter reads a minimum current of 2 μA and a maximum of 35 μA, determine the capacitance of the generating voltmeter. The speed of the drive motor is 1500 rpm. **(04 Marks)**

c. What is Rogowski coil? Explain with a neat diagram its principle of operation for measurement of high impulse currents. **(08 Marks)**

6 a. Explain the factors that influence the measurement of high voltage using sphere gaps. **(08 Marks)**
b. Write a note on Cathode-Ray oscillographs for impulse measurements. **(08 Marks)**
c. How is a compensated dc potential divider used to measure the dc voltage in HVDC systems? **(04 Marks)**

7 a. Explain the different theories of charge formation in clouds. **(08 Marks)**
b. With suitable figs explain the principles and functioning of,
(i) Expulsion gaps (ii) Protector tubes **(08 Marks)**
c. Write a note on characteristics of lightning strokes. **(04 Marks)**

8 a. Write a note on surge arresters. **(08 Marks)**
b. Explain the principles of insulation coordination on HV and EHV power system. **(08 Marks)**
c. Write a note on insulation levels at substations with protective zones. **(04 Marks)**

9 a. Explain the operation of Schering bridge for three terminal measurements. **(10 Marks)**
b. Explain discharge detection using straight detector for partial discharge measurement. **(10 Marks)**

10 a. A 33 KV, 50 Hz, high voltage Schering Bridge is used to test a sample of insulation. The various arms have the following parameters on balance. The standard capacitance 500 pF, the resistive branch 500 ohms and branch with parallel combination R and C, has 180 Ω and 0.15 μF. Determine the value of capacitance of this sample, its parallel equivalent loss resistance, the PF and power loss under these conditions. **(08 Marks)**
b. Write a short note on testing of cables. **(05 Marks)**
c. Explain the methods to test the insulators and bushings. **(07 Marks)**

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