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10EE73

Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. What are the industrial applications of high voltage? **(05 Marks)**

b. Explain the need of high voltage in the laboratory. **(05 Marks)**

c. With a neat sketch explain the principle and working of electrostatic painting. **(10 Marks)**

2 a. Derive an expression for the current in the air gap $i = i_0 e^{\alpha d}$ considering townsend first ionization coefficient. **(08 Marks)**

b. In an experiment in certain gas it was found that the steady state current is 6×10^{-8}A at 10kV at a gap spacing of 0.4cms between the electrodes keeping the field constant and reducing the gap spacing to 0.2cm a current of 10×10^{-9}A was obtained. Calculate the townsend primary ionization co-efficient of 'α'. **(06 Marks)**

c. What is meant by time lag of breakdown? Explain statistical and formative time lag. **(06 Marks)**

3 a. What are the limitations of townsend theory and explain the streamer's theory. **(10 Marks)**

b. Briefly explain electro mechanical break down and thermal breakdown in solid insulating materials. **(10 Marks)**

4 a. With the help of a neat sketch, explain how cascade transfer generates high voltage AC. **(06 Marks)**

b. Derive an expression for average ripple and voltage drop of a three stage HVDC circuit. **(08 Marks)**

c. Determine the average ripple and voltage drop of a 4 stage HVDC circuit with a stage capacitance of 4 μF and a load current of 500mA. Supply frequency is 50Hz. **(06 Marks)**

PART – B

5 a. 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)**

b. With the help of a neat sketch how impulse voltage can be developed in the laboratory by Marx circuit. **(08 Marks)**

c. Calculate the front and tail resistance for 5 stages. 1000kV with the capacitance of each stage is 5μF and a load capacitance of 10,000 pF for 1μs front and 50μs tail wave. **(06 Marks)**

6 a. Explain the working principle of generating voltmeter with a figure. **(08 Marks)**

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

c. Explain the factors that influence the measurement of high voltage using the sphere gap. **(08 Marks)**

7 a. With the help of a diagram of Schering bridge explain how capacitance and tan δ can be measured. **(08 Marks)**

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

c. Discuss the factors affecting the discharge detection. **(06 Marks)**

8 a. Explain in detail the testing of circuit breakers. **(10 Marks)**

b. What are the tests on transformer and explain in detail the impulse testing of transformer? **(10 Marks)**

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10EE73

Seventh Semester B.E. Degree Examination, June/July 2017
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Explain the need for generation of high voltages in the laboratory. Mention its applications. **(05 Marks)**

b. What are the advantages of transmitting electrical power at high voltage? Mention the industrial applications of high voltage. **(05 Marks)**

c. Describe the working principle of electrostatic precipitator and electrostatic painting. **(10 Marks)**

2 a. Define Townsend's first and second ionization co-efficient. Derive an expression for the current growth in a gas discharge due to secondary mechanism. **(10 Marks)**

b. What are electronegative gases? Why is the breakdown strength of these gases higher compared to that of other gases? **(05 Marks)**

c. A steady current of 600μA flows through the plane electrode separated by a distance of 0.5cm, when a voltage of 10KV is applied. Determine the Townsends's first ionization co-efficient if a current of 60μA flows when the distance of separation is reduced to 0.1cm and the field is kept constant at the previous value. **(05 Marks)**

3 a. What is thermal breakdown in "solid dielectrics" and how it is practically more significant than other mechanisms? **(06 Marks)**

b. Explain briefly suspended particle theory of breakdown in liquid dielectrics. **(06 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 (mm)	4	6	8	10
Breakdown voltage (KV)	88	135	165	212

(08 Marks)

4 a. Describe the working of a 3–stage Cockcroft Walton's cascaded DC generator. Derive the expressions for ripple and output voltage. **(08 Marks)**

b. 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. **(06 Marks)**

c. A ten-stage Cockcroft Walton circuit has all capacitors of 0.06μF. The secondary voltage of the supply transformer is 100 KV at a frequency of 150Hz. If the load current is 1 mA determine i) voltage regulation ii) the ripple iii) the optimum number of stages for maximum output voltage. **(06 Marks)**

PART – B

5 a. Describe the method of generation of impulse currents. Derive the related mathematical formulae. How are capacitors arranged in such circuits? **(07 Marks)**

b. Describe the Tesla coil with its equivalent circuit and output waveforms. Give the application of Tesla coil. Show that $v_2 = v_1\sqrt{\frac{c_1}{c_2}\eta}$ with usual notations. **(07 Marks)**

c. An impulse generator has eight stages with each capacitor rated for 0.16 micro-farad and 125 KV the load capacitor available is 1000 Pico-farad. Find the series resistance and the damping resistance needed to produce 1.2/50 micro-second impulse wave. What is the maximum output voltage of the generator if the charging voltage is 120 KV? **(06 Marks)**

6 a. Discuss how resistance potential dividers are used to mesure high voltages. Explain the effect of stray capacitances on such measurements and also suggest suitable remedial measure. **(10 Marks)**

b. Describe with a neat sketch the working of a generating voltmeter used to measure high DC voltages. **(06 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 $E_r = 1$]. **(04 Marks)**

7 a. What are partial discharges? Explain with a neat diagram the principle of pulse current measurement of partial discharges by straight detection technique. **(07 Marks)**

b. Describe the Schering bridge method of determining the capacitance and loss angle of a dielectric specimen. Derive the relevant formulae. **(07 Marks)**

c. A 33KV, 50Hz high voltage Schering bridge is used to test a sample of insulation. The various arms have the following parameters on balance. The standard capacitance 500pF the resistive branch 800ohm and branch with parallel combination of resistance and capacitance has valued 180 ohms and 0.15μF. Determine the value of the capacitance of this sample its parallel equivalent loss resistance the power factor and the power loss under these test conditions. **(06 Marks)**

8 a. With a neat diagram, explain the impulse testing of transformers. How are the faults detected and located? **(08 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. **(08 Marks)**

c. Explain any one method of testing cables. **(04 Marks)**

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Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What are the advantages and limitations of transmitting power at high voltages? Explain briefly. (10 Marks)

b. With a neat sketch explain the principle and working of electrostatic painting and coating. (10 Marks)

2 a. Derive the criterion for breakdown in electronegative gases and discuss the importance of electro-negative gases. (10 Marks)

b. Explain the streamer theory of breakdown in air at atmospheric pressure. (10 Marks)

3 a. Explain the various theories that explain the breakdown in commercial liquid dielectrics. (10 Marks)

b. Briefly explain electromechanical break down and thermal breakdown in solid insulating materials. (10 Marks)

4 a. Explain the schemes for cascade connection of transformers for producing very high AC voltages. (06 Marks)

b. What is tesla coil? How are the damped high frequency oscillations obtained from of tesla coil? (06 Marks)

c. A Cockraft-Waltons type voltage multiplier has eight stages with capacitance all are equal to 0.05μF. The supply transformer secondary voltge is 125kV at a frequency of 150Hz, if the load current to be supplied is 5mA. find i) the percentage ripple ii) Regulation. (08 Marks)

PART – B

5 a. With neat sketch explain the Marx circuit arrangement for multistage impulse generator. (10 Marks)

b. What is trigatron gap? Explain its function and operation. (06 Marks)

c. A 12 stage impulse generator has capacitor each rated at 0.3μF, 150kV. The capacitance of test specimen is 400pF. Determine the wave front and wave tail resistances to produces a 1.2/50μF. (04 Marks)

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

b. Briefly explain the factors affecting measurement of voltages using sphere gap. (06 Marks)

c. A resistance divider of 1400kV (impulse) has a high voltage arm of 16kΩ and L.V arm consisting of 16 members of 250Ω, 2 watt resistors in parallel. The divider is connected to a CRO through a cable of surge impedances 75Ω and is terminated at the other end through 75Ω resistor. Calculate the exact divider ratio. (04 Marks)

7 a. Explain method of measurement of capacitance and tan δ using H.V Schering bridge. (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)

8 a. What are the different power frequencies and impulse tests done on insulators? Mention the procedure for testing. (10 Marks)

b. Explain the method of impulse testing of high voltage, Transformers. What is the procedure adopted for locating the failure? (10 Marks)

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CRASH COURSE

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Seventh Semester B.E. Degree Examination, May 2017
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Enumerate the major applications of high voltages and their need for generation in laboratory. **(06 Marks)**

b. Explain the process of ionization by collision and hence derive the current growth equation. **(10 Marks)**

c. A steady current of 600 μA flows through the plane electrodes separated by a distance of 0.5cm when a voltage of 10KV is applied. Determine the Town send's first ionization coefficient if a current of 60μA flows when the distance of separation is reduced to 0.1cm and the field is kept constant at the previous value. **(04 Marks)**

2 a. Briefly write about Paschen's law and its significance. **(07 Marks)**

b. Discuss the time lags of break down, with a diagram for step function voltage pulse. **(07 Marks)**

c. Explain how breakdown occurs in liquid dielectrics due to cavitation and bubble theory. **(06 Marks)**

3 a. Write a note on electromechanical breakdown mechanism in solid dielectrics. **(07 Marks)**

b. With aid of related heat gain loss curves and energy conservation equations, explain Thermal mechanism of breakdown in solid dielectrics. **(08 Marks)**

c. An AC voltage of 60KV is applied between two parallel plates rounded at the edges and placed 2cm apart in air. A press board sheet of thickness 0.2cm is placed on the lower plate as shown in fig. Q3(c). Calculate the voltage across the air gap and the press board sheet. Given permittivity of press board = 4. **(05 Marks)**

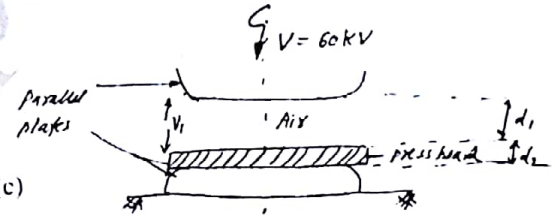

Fig.Q3(c)

4 a. State the advantages of series resonant circuit over cascade connection. **(05 Marks)**

b. Describe Tesla coil with its equivalent circuit and output waveform. Hence show that $V_2 = V_1\sqrt{\eta\frac{C_1}{C_2}}$ with usual notations. **(09 Marks)**

c. Three, 350 KV, 1 MVA testing transformers with 10% short circuit impedance are connected in cascade. Determine the short circuit current if flash over occurs when the transformers are excited to a voltage of 200 KV each. **(06 Marks)**

PART – B

5 a. Define Standard lightning impulse voltage wave with a neat sketch thereby mention its tolerance limits as specified by various international standards. **(04 Marks)**

b. Explain triggering of impulse generator by using trigation gap circuit schematic. **(08 Marks)**

c. A single stage impulse generator circuit has a stage capacitance of 0.1μF. The wave front and wave tail resistances are 285Ω and 540Ω respectively. The capacitance of insulator to be tested is 1000pf. If the charging voltage is 100KV then determine

i) Wave shape of impulse voltage wave (t1/t2) ii) Peak value of the output impulse

iii) Voltage efficiency of the generator. Iv) Impulse generator energy rating.

Given : $\alpha = 0.01813 \times 10^{n}$ and $\beta = 3.544 \times 10^{6}$. **(08 Marks)**

6 a. Explain the method of measuring HVDC using series resistance micro ammeter and hence write its limitations. **(08 Marks)**

b. Describe Chubb and Forfescue method of measuring high AC peak voltages. **(08 Marks)**

c. An absolute electrostatic has a movable circular plate of 8cms in diameter. If the distance between the plates during measurement is 4mm, determine the potential difference when the force of attraction is 0.2 gram weight. Given : 1 kg = 9.81N. **(04 Marks)**

7 a. Briefly explain the factors affecting measurement of voltages using standard sphere gap. **(10 Marks)**

b. Describe the method of measuring capacitance and tans δ using HV Schering bridge. **(10 Marks)**

8 a. Why partial discharge tests are performed on High voltage cables? Explain the method of conducting these tests on cables. **(10 Marks)**

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

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10EE73

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Explain the need for generation of very high voltages in the laboratory. (06 Marks)
b. What are the advantages of transmitting electrical power at high voltages? (06 Marks)
c. Describe the various components of electrostatic precipitator (ESP) and its principle of working. (08 Marks)

2 a. Write the preferred properties of gaseous dielectric for high voltage applications. Give any three examples of gaseous dielectric. (06 Marks)
b. Explain the process of ionization by collision and hence obtain the Townsend's current growth equation. (08 Marks)
c. In an experiment in a certain gas it was found that the steady state current is 5.5×10^{-9} 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. (06 Marks)

3 a. State and explain Paschen's law. (06 Marks)
b. Explain the following breakdown mechanism in solid:
i) Streamer breakdown. ii) Electromechanical breakdown. (14 Marks)

4 a. Explain with a neat figure, how cascade transformers generate high ac voltages. (08 Marks)
b. Explain the principle of operation of a resonant transformer. (06 Marks)
c. A Cockcroft-Walton type voltage multiplier circuit has eight stages with capacitances all equal to 0.05 μF. The supply transformer secondary voltage is 125 KV at a frequency of 150 Hz. If the load current to be supplied is 5 mA. Find
i) The voltage drop and regulation.
ii) The optimum number of stages for minimum voltage drop. (06 Marks)

PART – B

5 a. Explain the Marx circuit arrangement for multistage impulse generator. (08 Marks)
b. Explain the operation of a trigatron gap. (06 Marks)
c. A 12-stage impulse generator has 0.126 μF capacitors. The wavefront and wave tail resistances connected are 800 ohms and 5000 ohms respectively. If the load capacitor is 1000 pF, find the front and tail lines of the impulse wave produced. (06 Marks)

6 a. With a schematic diagram, explain the principle of operation of a generating voltmeter. (08 Marks)
b. Explain the Chubb and Forteswe method for measurement of peak value of an ac voltage waveform. (06 Marks)
c. Explain the principle of operation of an electrostatic voltmeter for measurement of very high dc and ac voltages. (06 Marks)

7 a. Explain the method of balanced detection for locating partial discharges in electrical equipment. (10 Marks)
b. Explain how capacitance and tan δ can be measured using a Schering bridge. (10 Marks)

8 a. Define the following terminologies: i) Disruptive discharge voltage.
ii) Fifty percent Flashover voltage. iii) Impulse voltages. (06 Marks)
b. Write brief notes on: i) Testing on insulators. ii) Testing of cables. (14 Marks)

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10EE73

Seventh Semester B.E. Degree Examination, June/July 2015
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Missing data may be suitably assumed.

PART – A

1 a. What are the advantages of transmitting electrical power at high voltages? **(06 Marks)**
b. Explain in brief the need for generating high voltages in the laboratory. **(06 Marks)**
c. What are the industrial applications of high voltages? **(08 Marks)**

2 a. Define Townsend's first and second ionization coefficients. Derive from fundamentals the coefficients. Derive from fundamentals the current growth equations and hence the Townsend's criterion for breakdown. **(10 Marks)**
b. Derive and explain Paschen's law. **(05 Marks)**
c. Explain briefly formative time lag and statistical time lag. **(05 Marks)**

3 a. Explain any two theories that explain breakdown in commercial liquid dielectrics. **(10 Marks)**
b. Explain the electromechanical breakdown of solid dielectrics. **(05 Marks)**
c. A solid specimen of dielectric has a dielectric constant 4.2 and tan δ = 0.001 at frequency of 50Hz. If it is subjected to an alternating field 50kV/cm. Calculate the heat generated in the specimen due to the dielectric loss. **(05 Marks)**

4 a. Explain how high direct current, voltages can be generated using a Cockcroft Walton circuit. **(07 Marks)**
b. With the help of a neat sketch, explain the construction and working principle of cascading of transformers of three units. **(07 Marks)**
c. A Cockcroft-Walton type multiplier has right stages with capacitances, all equal to 0.05μF. The supply transformer secondary voltage is 125kV at frequency of 150 Hz. If the load current to be supplied is 5mA, find: i) the percentage of ripple and ii) Regulation. **(06 Marks)**

PART – B

5 a. Explain how impulse voltages are generated in a laboratory using Marx circuit. **(08 Marks)**
b. Explain the working principle of a Trigatron gap tripping circuit used for the impulse generator. **(06 Marks)**
c. A 12 stage impulse generator has 0.126 μF capacitors. The wave front and the wave tail resistances connected are 800 ohms and 5000 ohm respectively. If load capacitor is 1000pF. Find the front and tail times of the impulse wave produced. **(06 Marks)**

6 a. Describe with a neat sketch, the working of a generating voltmeter used to measure high D.C. voltages. (08 Marks)

b. Explain the principle and construction of an electrostatic voltmeter for the measurement of high voltages. (08 Marks)

c. What are the factors influencing the sparkover voltages of sphere gaps? (04 Marks)

7 a. Explain the construction and principle of operation of H.V. Schering bridge used for dielectric loss and loss angle measurements. Derive the expression used. (08 Marks)

b. Discuss the method of discharge detection using straight detectors. (08 Marks)

c. A Schering bridge was used to measure the capacitance and loss angle of an H.V. brushing. At balance, the observations were: the value of the standard condenser = 100 pF, R_3 = 3180 Ω, C_3 = 0.00125 μF and R_4 = 636Ω. What are the values of capacitances and tan δ of the brushing? (04 Marks)

8 a. Mention the different electrical tests done on circuit breakers. (10 Marks)

b. Describe various electrical tests done on transformers. (10 Marks)

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10EE73

Seventh Semester B.E. Degree Examination, Dec.2014/Jan.2015
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer any FIVE full questions, selecting atleast TWO questions from each part.*

PART – A

1 a. Explain the advantages of transimitivity power at higher voltages and mention the highest transmission voltages of AC + DC in India at present. **(07 Marks)**

b. Define Townsend first and second ionization coefficient. Derive an expression for the current growth in gar discharge considering secondary emission. **(08 Marks)**

c. In an experiment in a certain gas it was found that steady state current 5.5×10^{-8}A at 8kV at a distance of 0.4cm between the electrodes. Keeping the field constant and reducing the distance to 0.1cm results in, a current of 5.5×10^{-9}A. Calculate the Townsend's primary ionization coefficient 'α' neglect secondary ionization effects. **(05 Marks)**

2 a. State and explain Pascheris law with necessary diagram. **(06 Marks)**

b. What is meant by time lag and define both the types of time lags with the help of a diagram. **(06 Marks)**

c. Explain clearly the electromechanical breakdown in solid dielectric and suspended particle theory in liquid dielectric. **(08 Marks)**

3 a. What are the limitation of Townsend theory and explain clearly the Streamer's mechanism of breakdown in gases. **(08 Marks)**

b. What is meant by corona discharge? Explain the breakdown in electro negative gases. **(07 Marks)**

c. Explain in detail what is meant by electro convection breakdown in transformer. **(05 Marks)**

4 a. Explain the working principle of a cascaded transformer with a neat sketch. **(07 Marks)**

b. With a neat sketch, explain the construction and working of a series resonant circuit. **(06 Marks)**

c. A Cockroft-Waltar type multiplier has eight stages with capacitances equal to 0.15μF. The supply transference secondary voltage is 125kV (peak) at a frequency of 50Hz. If the load current is 5mA, find: i) % age ripple; ii) regulation and iii) The optimum number of stages to obtain maximum output voltage. **(07 Marks)**

PART – B

5 a. Explain how impulse voltages are generated in laboratory using MARX circuit. **(07 Marks)**

b. An impulse generator has eight stages with each capacitor rated for 0.16μF and 125kV. The load capacitor available is 5000pF. Find the series resistance and damping resistance needed to produce 1.2/50μs impulse wave. What is the maximum output voltage of the generator, if the charging voltage is 120kV? **(07 Marks)**

c. With the help of a neat sketch, explain the working of impulse current generator. **(06 Marks)**

6 a. With a neat sketch, explain the construction and working principle of electrostatic voltmeter. Bring out the advantages and disadvantages. (08 Marks)

b. Explain the working principle of generating voltmeter with a neat sketch. (06 Marks)

c. Discuss in detail the factors affecting the measurement of high voltage using sphere gap. (06 Marks)

7 a. With the help of a neat sketch, explain the construction and principle of H.V. schering bridge used for dielectric loss angle measurements. Derive the expressions used. (07 Marks)

b. What is meant by partial discharge? Explain the measurement of partial discharge with a neat sketch. (07 Marks)

c. Explain how peak value of high voltage AC is measured using Chubb-Fortescue method. (06 Marks)

8 a. Explain with a neat diagram, the procedure for impulse testing of power transformer. (08 Marks)

b. Write short notes on:

i) Testing of cables and insulated.

ii) Voltage double circuit.

iii) Trigatron gap.

iv) Lightning and switching impulse voltage definitions with tolerances. (12 Marks)

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10EE73

Seventh Semester B.E. Degree Examination, Dec.2013/Jan.2014
High Voltage Engineering

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. What are the industrial applications of high voltage? **(06 Marks)**

b. Explain the need of high voltage in the laboratory. **(06 Marks)**

c. Describe the working principle of electrostatic precipitator and electrostatic painting. **(08 Marks)**

2 a. Derive an expression for the current in the air gap that is $i = i_0 e^{\alpha d}$ considering town send first ionization coefficient. **(06 Marks)**

b. In an experiment in certain gas it was found that the steady state current is 6×10^{-8} A at 10kV at a gap spacing of 0.4 cms between the electrodes. Keeping the field constant and reducing the gap spacing to 0.2cm a current of 10×10^{-9} A was obtained. Calculate the Townsend primary ionization coefficient of α. **(06 Marks)**

c. Derive an expression for the current in the airgap, that is $i = \frac{i_0 e^{\alpha d}}{[1-\gamma(e^{\alpha d}-1)}$ considering secondary ionization coefficient. **(08 Marks)**

3 a. What are the limitations of Townsend theory and explain the Streamer's theory. **(08 Marks)**

b. What is meant by time lag of break down? Explain statistical and Formative time lag. **(04 Marks)**

c. Explain how thermal break down and electromechanical breakdown occurs in solid dielectric. **(04 Marks)**

d. Describe Bubble theory and electro convection break down in liquid dielectric. **(04 Marks)**

4 a. With the help of a neat sketch, explain how cascade transformer generate high AC voltages. **(06 Marks)**

b. With a neat diagram of Walton-Multistage HVDC circuit explain how high voltage DC is generated in laboratory. **(06 Marks)**

c. Derive an expression for average ripple in 'n' stage HVDC set for a load current of I, frequency 'f' and stage capacitance of 'c'. **(04 Marks)**

d. Determine the average ripple and voltage drop of a 4 stage HVDC set with a stage capacitance of 4 μF and for a load current of 500 mA. Supply frequency is 50 Hz. **(04 Marks)**

PART – B

5 a. With the help of the neat diagram explain how lightning impulse voltage can be developed in the laboratory by Marx circuit. **(08 Marks)**

b. With the help of a neat sketch how impulse current is generated in the laboratory. **(06 Marks)**

c. Calculate the front and tail resistance for 5 stage, 1000 kV with the capacitance of each stage is 5μF and a load capacitance of 10,000 pF for 1μs front and 50μs tail. **(06 Marks)**

6 a. Explain with a neat diagram how high voltage can be measured using electrostatic voltmeter. **(05 Marks)**

b. Describe in detail how peak ac voltage is measured using Chubb and Fortescue circuit. **(05 Marks)**

c. Explain how and why a sphere gap is used for measurement of high voltage. Explain the factors that influence the measurement using sphere gap. **(10 Marks)**

7 a. With the help of a diagram of Schering Bridge Explain how capacitance and tan δ can be measured. **(06 Marks)**

b. What is meant by partial discharge? Explain how it is measured using straight method and balance method. **(08 Marks)**

c. Discuss the factors affecting the discharge detection. **(06 Marks)**

8 a. Explain in detail the testing of circuit breaker and insulators. **(06 Marks)**

b. What are the tests on transformer and explain in detail the impulse testing of transformer? **(08 Marks)**

c. Write short notes on: i) Paschen's law and ii) Rogowsky's coil. **(06 Marks)**

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