International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B. Sc. Engineering in EEE

Final Exam, Autumn 2021

Course Code: **EEE 4807** Course Title: **High Voltage Engineering**

Time: 2 hours 30 minutes Full Marks: 50

(i) The figures in the right-hand margin indicate full marks

(ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

Course Outcomes (COs) of the Questions	
CO1	Reflect a basic understanding of breakdown criterion in different insulating materials (gases, liquids, and solids) which are used in power system equipment's, generation method of high voltages both AC & DC, insulation coordination, measurement of high voltage techniques etc.
CO2	Demonstrate the problem solving of different types of high voltages engineering circuits.
CO3	Design the mathematical model for lightning phenomena and corresponding high voltage engineering circuits.

Bloom's Levels of the Questions						
Letter Symbols	**R**	**U**	**App**	**An**	**E**	**C**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1. a)	What are the components of multi-stage impulse generator? With a neat sketch, analyze the Marx and modified Marx circuits for high impulse voltage generation.	CO1	R, An	5
1. b)	An eight stage impulse generator has a stage capacitance of 0.13 microfarad and a charging voltage of 175 kV. The test specimen capacitance is 500pF. Find the wave-front and wave-tail resistances needed to produce 1.2/50μs impulse wave. What will be the maximum output voltage?	CO2	E	5
2. a)	Define Townsend's first ionization coefficient. Derive the equation $I = I_0 e^{\alpha d}$, where symbols have their usual meaning.	CO1	R, E	5
2. b)	A solid specimen of dielectric has a dielectric constant of 4.2, and tanδ = 0.001 at a frequency of 50 Hz. If it is subjected to an alternating field of 50kV/cm, calculate the heat generated in the specimen due to the dielectric loss.	CO2	E	5

Or,

2. a)	i. Compare Pure Liquids and Commercial Liquids.	CO1	An, U	5
	ii. Describe the Solid Dielectric failure due to treeing and tracking.			

2.	b)	In an experiment in a certain gas, it was found that the steady state current is $5.5 \times 10^{-8}\ A$ at 8KV at a distance of 0.4 cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1cm results in a current of $5.5 \times 10^{-9}\ A$. Calculate Townsend's primary ionization coefficient (α).	**CO2**	**E**	**5**

Part B

[Answer the questions from the followings]

3.	a)	Explain the dc resistance measurement test for solid dielectric.	**CO1**	**C**	**5**
3.	b)	Design a peak reading voltmeter along with a suitable micro ammeter such that it will be able to read voltages, up to 1000 kV (peak). The capacitance potential divider available is of the ratio 1000 : 1.	**CO3**	**C**	**5**
		Or,			
3.	a)	Explain the high DC voltage measurement techniques based on high ohmic series resistance with Micrometer. Discuss its advantages and limitations for high voltage measurements.	**CO1**	**C,U**	**5**
3.	b)	A generating voltmeter has to be designed so that it can have a range from *20 to 200 KV DC*. If the indicating meter reads a minimum current of $2\mu A$ and maximum current $25\mu A$, what should be the capacitance of the generating voltmeter?	**CO3**	**E**	**5**
4.	a)	Explain the Volt-Time Curve with proper net sketch.	**CO1**	**C**	**5**
4.	b)	Define insulation co-ordination. How are the protective device chosen for optimal insulation level in power systems?	**CO3**	**R, An**	**5**
5.	a)	What are the causes of over voltage? Explore the mechanism of lightning and mathematical model of lightning.	**CO3**	**R, An**	**5**
5.	b)	Explain the Surge Arrestor with proper net sketch.	**CO1**	**C**	**5**