

## **HIGH VOLTAGE ENGINEERING**

**EE-704A**

**Credit: 3**

**Contact: 3L**

### **Module 1**

#### **Breakdown phenomena:**

Breakdown of Gases: Mechanism of Break down of gases, Charge multiplication, Secondary emission, Townsend Theory, Streamer Theory, Paschen's Law, Determination of Minimum breakdown voltage, Breakdown in non uniform field, Effect of polarity on corona inception and break down voltage.

Partial Discharge: definition and development in solid dielectric.

Break Down of Solids: Intrinsic breakdown, Electromechanical break down, Thermal breakdown, Streamer Breakdown.

Breakdown of Liquid: Intrinsic Break down, Cavitation Theory, Suspended particle Theory.

Breakdown in Vacuum: Non metallic electron emission mechanism, Clump mechanism, Effect of pressure on breakdown voltage. [12]

### **Module 2**

#### **Generation of High Voltage:**

Generation of high AC voltages: Testing transformer, Cascaded transformer, Series resonant circuit, single stage and multi stage. Advantages of Series Resonant Circuit in testing of cables.

Generation of DC high voltage: Cockcroft Walton doubler and multistage circuit.

Electrostatic generator.

Definition of Impulse Voltage as per Indian Standard Specification, Wave front and wave tail time ,Generation of Impulse Voltage, Multistage

Impulse generator, triggering of Impulse Generator. [10]

### **Module 3**

#### **Measurement of High Voltage:**

Sphere gap voltmeter, AC , DC and impulse high voltage measurement as per Indian Standard Specifications.

Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high AC voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the

measurement of DC high voltage, Electrostatic Voltmeter [06]

### **Module 4**

#### **Transient in power systems:**

Lightning Phenomena, Electrification of cloud, Development of Lightning Stroke, lightning induced over voltage, direct stroke, indirect stroke.

Protection of Electrical Apparatus against over voltage, Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Ground wires.

Insulation Co ordination, Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment. [08]

### **Module 5**

#### **High Voltage Testing:**

High Voltage testing, Testing as per Indian Standard Specifications, Power frequency withstand, induced over voltage and impulse test on transformers, Power frequency wet withstand test and impulse test on insulators [04]

**Numerical problems to be solved in the class.**

#### **Text Books:**

1. High Voltage Engineering, C.L. Wadhawa, New Age International Publishers.
2. High Voltage Engineering, M.S. Naidu & V. Kamraju, Tata MC Graw Hill publication.
3. Book of Bgamude.

#### **Reference Books:**

1. High Voltage Engineering, M.A. Salem, H. Anis, A. E. Morahedy, R. Radwan, Marcel Dekker, Inc.