Course Syllabi: UEE502 High Voltage Engineering (L : T : P :: 3 : 0 : 2)

1. **Course number and name:** UEE502; High Voltage Engineering

2. **Credits and contact hours:** Credits: 4.0; Hours: 5

3. **Text book, title, author, and year**

   - *Khalifa, M., High Voltage Engineering: Theory and Practice, Marcel Dekker Inc. (2000).*
   - *Naidu, M.S. and Kamraju, V., High Voltage Engineering, Tata McGraw–Hill (2008).*
   - *Wadhwa, C .L. High Voltage Engineering, New Age International (P) Limited, Publishers (2006).*
   - *Dass, R., Extra High Voltages, Tata McGraw–Hill (2006).*
   - *Kind, D. and Feser, K, High Voltage Test Techniques, Reed Educational and Professional Publishing Limited (2001).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Introduction to AC and DC impulse high voltages and their use, Problems in dealing with high voltages.

   Breakdown in Gases: Elementary ideas on ionization by electron collision, Townsend mechanism, Townsend first and second ionization coefficients, Paschen law, Breakdown in non-uniform fields and corona discharges, Vacuum breakdown mechanisms, Breakdown in liquids, Fundamentals of insulating oils, Conduction and breakdown in pure and commercial liquids.

   Breakdown in Solids: Fundamentals of solid insulating materials intrinsic, Electromechanical and thermal breakdown. Breakdown in simple and composite dielectrics. Insulation design principles: Types of insulating materials, Temperature classification, Factor affecting dielectric strength, Insulation design of rotating machines, Transformers, Transmission lines, Switch gear. etc.

   Generation of High Voltages: Generation of high voltages. Characteristics parameters of high alternating voltages, Testing transformers in cascade, Series Resonant Circuits and their advantages; Characteristics parameters of high direct voltages; Half and Full wave rectifier circuits. Voltage doubler and cascade circuits, Electrostatic generator, Characteristics parameters of impulse voltages, Single state impulse generator circuits, Analysis and calculations of circuit parameters, Multistage impulse operation circuits, Tripping of impulse generator and synchronization with oscilloscope.

   Measurement of High Voltages: Measurement of direct, Alternating and impulse voltages by electrostatic voltmeters, Sphere gap, Uniform field gap, Ammeter in series with high voltage resistors and voltage divider (Resistive, Capacitive and mixed).

   Non-Destructive High Voltage Tests: Loss in a dielectric, Dielectric loss measurement by schering bridge, Partial discharges at alternating voltages; External and internal partial discharges and discharge measurements.

   Laboratory Work

   Alternating voltages, Voltage measurement by sphere gap and Chubb and Fortesque methods. Impulse voltage: Experimental setup for standard lightning wave, Efficiency and peak voltage

measurement by sphere gap impulse voltage time curves. Use of standard software package for the Electric Stress calculations in H.V. bushings. Liquid dielectric: Breakdown voltage, Conductivity and Dissipation Factor measurement with Schering Bridge, Partial discharge measurements.

5. **Specific goals for the course**

After the completion of the course, the students will be able to:

- Conceptualize the idea of high voltage and safety measures involved.
- Analyse the breakdown mechanism of solids, liquids and gases.
- Design insulation associated with various power system components such as transformer, rotating machines and switchgear.
- Analyse and calculate the circuit parameters involved in generation of high voltages.
- Measure direct, alternating and impulse high voltage signals.
- Measure the dielectric loss and partial discharge involved in non-destructive high voltage tests.

6. **Brief list of topics to be covered**

- Breakdown in Solids
- Breakdown in Gases
- Generation of High Voltages
- Measurement of High Voltages