

ADDIS ABABA UNIVERSITY
AAIT
ELECTRICAL & COMPUTER ENGINEERING
SCHOOL

COURSE DESCRIPTION FOR
TRANSIENTS & HIGH VOLTAGE ENGINEERING, MSC PROGRAM

Instructor: Dr.-Ing. Getachew Biru

Course Description and Scope:

Electric power networks systems are exposed daily to transients induced by lightning and switching operations. These transients contain tremendous amounts of energy, which if not accounted can damage or destroy electrical apparatus. Good designs of power systems and devices connected to the network examine the impact of transients. Transients produce H.V in power systems and power equipments. Designing the power system and power equipments against H.V transients require knowledge of dielectric properties and breakdown mechanisms. This course addresses the broad range of transient issues, dielectric breakdown mechanisms, insulation test and H.V measurement techniques.

Course objective:

- Understand and calculate transient problems in power networks.
- Understanding of the basics of dielectric physics of insulating materials.
- Understanding the conduction and breakdown mechanisms in gaseous, liquid and solid insulating materials.
- Understand high voltage insulation coordination and testing.
- Understand how to produce and measure high-voltages.

Course outline:

1. Analysis of Transient in Power System
 - 1.1. Fundamental circuit analysis
 - 1.2. The Laplace Transform
 - 1.3. Switching and abnormal transients
 - 1.4. The behavior of windings under transient conditions

2. Basics of Electromagnetic Phenomena
 - 2.1. Electric field stress
 - 2.2. Estimation of electric field in some geometric boundaries
 - 2.3. Overview of numerical methods in field computation
3. Conduction and Breakdown in Gases
 - 3.1. Ionization process
 - 3.2. Townsend's current growth equation
 - 3.3. Streamer theory
 - 3.4. Paschen's Law
 - 3.5. Breakdown in non-uniform fields and corona Discharge
 - 3.6. Practical considerations in using gases for insulation purpose
4. Conduction and Breakdown of Liquid and Solid Dielectrics
 - 4.1. Breakdown in liquid dielectric materials
 - 4.2. Breakdown in solid dielectrics
 - 4.3. Distribution of potential over suspension insulators
5. Generation and Measurement of High Voltages
 - 5.1. Generation of high voltage
 - 5.2. Measurement of H.V voltage
6. Over Voltage Phenomena and H.V Protection
 - 6.1. Traveling wave in transmission line
 - 6.2. Natural causes of over voltages
 - 6.3. Principle of insulation coordination and H.V protection

The assessment is done as follows:

Assignment	40 %
Final Exam	60 %
Total	100 %

References

1. Greenwood: *Electrical Transients in Power Systems*
2. Razevig: *High Voltage Engineering*
3. C. Bayliss: *Transmission and Distribution Engineering*
4. C. William: *Elements of Power System Analysis, 4th Ed.*