



INGÉNIERIE ET SYSTÈMES HAUTE TENSION

HIGH VOLTAGE ENGINEERING AND SYSTEMS

Lecturers: Ayyoub ZOUAGHI, N'Gnui Thomas AKA

| Lecturers : 10 | TC : 6 | PW : 4 | Autonomy : 4 | Study : 8 | Project : 0.0 | Language : FR

Objectives

The development of the futur energy network is conditioned by the mastery of the major technical problems related to the transmission of increasingly large quantities of electrical energy to consumption centers which may be located thousands of kilometers away. The main way to increase the power to be transported and reduce losses is to increase the transmission voltage. This increase in voltage depends on the insulation systems of the components used and their resistance to various constraints, particularly electrical. The objective of this course is to provide the necessary bases for understanding the dielectric breakdown of materials under high voltage stresses, and the rules for the dimensioning of more reliable systems.

Keywords : High voltage ; dielectric materials ; plasma and discharge ; space charge ; partial discharge ; breakdown ; HVDC network

Programme

1. HVAC and HVDC energy networks and components ; new constraints and challenges of futur electrical networks ; environmental impact of materials.
2. Dielectric materials: Polarization, conduction, relaxation, losses.
3. Plasma and gas discharges: From micro-discharge to lightning.
4. Dielectric strength of solid and liquid materials: Breakdown ; partial discharge ; aging ; new materials.
5. Design of high voltage components (transformers, gas insulaed switchgear, cables...).

Learning outcomes

- Understand the technological and environmental challenges related to high voltage grids.
- Understand the consequences of strong electric fields on materials and systems.
- Get the necessary tools for the conception of reliable energy grid components.

Independent study

- Objectifs :** Make the right choice of materials for a given system.
Practical work : Corona effect in HVDC lines; surface discharges ; breakdown voltage measurement, protection against lightning.
Study and design : Numerical simulation of the electric field using Comsol Multiphysics; simulation of partial discharges under Matlab/Simulink.
- Méhodes :** Bibliographic study and / or realization of projects by groups of students.
Preparation of the oral presentation.
Construction of visual supports and associated explanations.

Core texts

- P. Robert, *MATÉRIAUX DE L'ELECTROTECHNIQUE, VOLUME II, TRAITÉ D'ELECTRICITÉ, D'ELECTRONIQUE ET D'ELECTROTECHNIQUE, EPFL* , 2007
A. Küchler, *HIGH VOLTAGE ENGINEERING, FONDAMENTALS, TECHNOLOGY, APPLICATIONS* , 1996
R. Fournié, R. Coelho, *DIÉLECTRIQUES – BASES THÉORIQUES*, Techniques de l'Ingénieur, 2003

Assessment

Final mark = 50 % Knowledge + 50 % Know-how
Knowledge = 100 % Final exam. Know-how = 100 Continuous assessment