FEI3230 Physics of Dielectric Insulating Materials 8.0 credits

Dielektriska isolermaterials fysik

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FEI3230 valid from Autumn 2011

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

MSc in electrical engineering, physical engineering or similar

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course, the student should be able to:

- describe polarisation processes with suitable relaxation functions in time domain and complex permittivity functions in frequency domain
- compute the relaxation function from the complex permittivity and vice versa
- identify the fundamental physical mechanism behind given relaxation/permittivity curves
- explain the different mechanisms that may lead to dielectric breakdown
- compute estimates of the electrical breakdown voltage from given models
- describe the different aging mechanisms in electrical insulation systems
- analyze the information contained in the temperature dependence of dielectric materials

Course contents

The dominating part of the course is about properties of dielectric materials when they are used as passive electric insulation in high voltage devices. Gases, liquids and solids are covered. The nature of the dielectric response from stimulus of an electric field is discussed: polarisation and depolarisation as a relaxation process and charge transport (conduction) processes. High field effects such as charge injection and dielectric breakdown mechanisms are discussed. Space charges of importance for DC insulation. Aging phenomena and long time behaviour. Representation in time and frequency domain. Relaxation in different frequency bands. Some part is devoted to 'sensor properties', i.e. optical/electro-optic, ferroelectric, piezoelectric, and pyroelectric and electret properties.

Disposition

Lectures (12*2h = 24h), 6 homework problems, presentations by participants on solutions to homework problems (2*6h = 12h), 72 h take home exam

Course literature

Kwan Chi Kao, **Dielectric Phenomena In Solids**; Compendia: H.Edin, **Physics of dielectric insulating materials**, containing lecture notes, articles and selected chapters from other books.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Participated (short presentation every time) in 5 out of 6 homework problems. 5 accepted solutions (about 80% correctness) to homework problems, 60% correct on home exam.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.