Classical Electrodynamics

Programme course

6 credits

Elektromagnetisk fältteori och vågutbredning

TFYY67

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Replaced by
TFYT04

Main field of study
Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
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- Applied Physics and Electrical Engineering, M Sc in Engineering
- Physics and Nanoscience, Master's programme
- Materials Science and Nanotechnology, Master's programme
- Applied Physics and Electrical Engineering - International, M Sc in Engineering

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Introductory course in electromagnetism, vector analysis, integral- and differential calculus in many variables, complex analysis, Fourier transformation.

Intended learning outcomes

The course is intended to give a good knowledge about Maxwell's equations, methods to solve these equations and various types of electromagnetic systems of interest for technological applications as well as from a fundamental point of view. The students are expected to attain a very deep and solid understanding of electromagnetism and to become well prepared for higher studies.
The learning goals are as follows:

- with the use of Maxwell's equations on differential form be able so solve problems in electromagnetism.
- with the use of other basic, empirical, relations like the Biot Savart's law or the generalized Coulomb's law be able to determine the fields resulting from given sources in the form of charge or current densities.
- to be able to utilize the symmetry properties of the given problem to simplify the calculations.
- to be able to, in a proper way, use the material parameters, that modify the fields inside a medium compared to in vacuum.

Course content

Maxwell's equations on differential form are derived and potentials are introduced. Fourier transforms are used extensively. Several different, complementary, methods are used to solve the Laplace and Poisson equations: separation of variables; conformal mapping; analytical functions; mirror images. Multipole expansions are discussed. The rest of the course can be divided into wave generation and wave propagation. In the first part the radiation from accelerating charges is treated. We introduce Lienard-Wichert potentials and antenna theory. We discuss how fields are generated in practical applications, like in the microwave oven. We study wave propagation in different materials and at interfaces, especially at metal surfaces. The concept electromagnetic normal mode is introduced. These normal modes are used to find the van-de-Waals and Casimir forces between objects. To link to one of the research fronts these techniques are applied to graphene. Finally, relativistic electrodynamics is treated and 4-vectors are introduced.

Teaching and working methods

Seminars presenting theory and problem solving sessions.

Examination

UPG1	Optional homework problems	0 credits	U, G
TENA	Exercise/Written Examination	6 credits	U, 3, 4, 5

The points obtained on the homework problems are added to the points obtained on the written examination. The homework points can only be used during the year they were obtained.

Grades
Four-grade scale, LiU, U, 3, 4, 5

Department
Institutionen för fysik, kemi och biologi

Director of Studies or equivalent
Magnus Johansson

Examiner
Ferenc Tasnadi

Education components
Preliminary scheduled hours: 40 h
Recommended self-study hours: 120 h

Course literature
David J. Griffiths, Introduction to Electrodynamics, Addison-Wesley.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.