

Electromagnetic Field Theory and Electromagnetism

Programme course

6 credits

Ellära och elektromagnetism

TNE056

Valid from: 2017 Spring semester

Determined by

Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined

2017-01-25

Main field of study

Electrical Engineering, Applied Physics, Physics

Course level

First cycle

Advancement level

G2X

Course offered for

- Electronics Design Engineering, 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

Physical modelling, Multivariable calculus, Vector calculus

Intended learning outcomes

After completion of the course a student is expected

- to understand fundamental laws of electromagnetism (Coulomb's law, Gauss law, Ohm's law, Amper's law, Faraday's law etc.), as well as fundamental concept such as potential, capacitance, current, resistance, inductance, e.m.f., electromagnetic induction, etc.
- to be able to apply fundamental laws of electromagnetism to perform practical calculations (e.g. calculate potential, electric and magnetic fields, capacitance, inductance, e.m.f., etc. for basic model systems)
- to be able to relate fundamental laws of electromagnetism to various technological applications as well as to everyday life phenomena
- to be able to use the laws of electromagnetism in subsequent courses (such as Modern Physics, Semiconductor devices, Introduction to Material Science, Photonics etc.).

The course aims to give students knowledge of electromagnetism which is essential for continued studies in physics, esp. in the area of electronics.

Course content

- Fundamental theory of electrostatics: Coulombs law, electrostatic potential and field, superposition principle, dipole and generalised multipoles. Brief description of electrostatic fields in conductors and dielectric materials, polarisation and permittivity, Gauss law, Poisson's and Laplace's equations and boundary conditions.
- Fundamental theory of magnetism: magnetic field strength, Biot-Savart law, divergence and curl of magnetic fields. Magnetism in media, magnetisation, para-, ferro- and diamagnetic materials.
- Maxwell's equations and the electromagnetic field. Electromagnetic waves in vacuum, energy density and Poynting's vector.
- EM waves in dielectric and conducting materials: group velocity and the index of refraction. Reflection, refraction and polarisation. Waveguides.

Teaching and working methods

The course is divided into lectures and tutorials.
The course runs over the entire spring semester.

Examination

KTR1	Individual assignments	0 credits	U, G
UPG1	Assignments	1.5 credits	U, G
TEN1	Written examination	4.5 credits	U, 3, 4, 5

Grades

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

Other information

Supplementary courses: Modern physics

Department

Institutionen för teknik och naturvetenskap

Director of Studies or equivalent

Adriana Serban

Examiner

Igor Zozoulenko

Course website and other links

<http://www2.itn.liu.se/utbildning/kurs/>

Education components

Preliminary scheduled hours: 54 h

Recommended self-study hours: 106 h

Course literature

Halliday, Resnick and Walker, "Fundamentals of Physics" (John Wiley & Sons) 2008; Lars Engström och Peter Münger, "Exempelsamling i Elektromagnetism" "Extra uppgiftssamling för TNE056" (finns på http://staffwww.itn.liu.se/~igozo/ellara/ADditional_exercises.pdf).

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://stydokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.