# Electromagnetism - Theory and Application

Programme course

8 credits

Elektromagnetism - teori och tillämpning

TFYA69

Valid from: 2017 Spring semester

**Determined by**
Board of Studies for Computer Science and Media Technology

**Date determined**
2017-01-25

## Main field of study
Applied Physics, Physics

## Course level
First cycle

## Advancement level
G2X

## Course offered for
- Information Technology, 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
Calculus, Mechanics, Wave physics.

## Intended learning outcomes
The course aims to give an introduction electromagnetism and the role it has in applications of technical relevance. After successful examination the student should be able to;

- solve problems related to electrostatics and magnetostatics
- solve problems related to induction and electromagnetic waves
- independently using electromagnetic theory to solve with problems
- relate theory to applications based on electric and magnetic phenomena
- calculate and visualize electromagnetic fields using computer simulations
- conduct basic measurements related to electromagnetic fields

## Course content

Relevant mathematical concepts: Coordinate systems scalar fields and vector fields.
Electrostatics: Electric Field Intensity, Coulomb's law, Potential, Gauss's law.
Magnetostatics: Steady Electric Currents, Current Density, Equation of Continuity, Magnetic Flux Density, Biot-Savart law, Ampere's Circuital law, Magnetic Materials, Magnetic Circuits, Magnetic Dipole, Motion of Charged Particles in Electromagnetic Fields.
Dielectric and magnetic materials: Capacitance, Resistance, Electric Dipole, Polarization, Electrostatic Energy and Forces. Magnetization, Magnetostatic Energy and Forces.
Induction: Time-Varying Electromagnetic Fields, Faraday's law, Electromotive Force, Displacement Current Density.
Electromagnetic Waves: Poynting Vector. Reflection and refraction.
Applications related to electromagnetism: wireless communication, memory technology, etc.
For the interested few, vector calculus and electromagnetic theory on differential form: Divergens, curl, Gauss's and Stoke's theorems. Poisson's and Laplace's Equations. Method of images. Boundary conditions.

## Teaching and working methods

Lectures, Problem solving sessions, Laboratory work. Problem based learning and group activities.

## Examination

| | | | |
|---|---|---|---|
| UPG1 | Hand-in assignments | 1 credits | U, G |
| KTR1 | Written test | 0 credits | U, G |
| BAS1 | Tutorial work | 2 credits | U, G |
| LAB1 | Laboratory work | 1.5 credits | U, G |
| TEN1 | Written examination | 3.5 credits | U, 3, 4, 5 |

The optional assignments may give bonus points on the written exam.

## Grades

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

## Other information

Supplementary courses: The course content is relvant for several upcoming courses on the programme (Linjära system för kommunikation, Automatic Control, Bachelor project and courses on the advanced level).

## Department
Institutionen för fysik, kemi och biologi

## Director of Studies or equivalent
Magnus Johansson

## Examiner
Jens Jensen

## Course website and other links
http://cms.ifm.liu.se/edu/coursescms/elektromagnetism/

## Education components
Preliminary scheduled hours: 96 h
Recommended self-study hours: 117 h

## Course literature
•Kursboken utgörs av: Lars Alfred Engström, Elektromagnetism - från bärnsten till fältteori [ISBN 9789144015101], köps tex. på Bokakademin •Ett Kurskompendium med material till föreläsningar och lektioner. Laddas hem via kursrummet. Finns också att köpa på Bokakademin. •Laborationsinstruktioner och andra dokument som också laddas hem via kursrummet.

# 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.