



Faculty of Health, Science and Technology
Physics
Syllabus

Course Approval

The syllabus was approved by the Faculty Board of Health, Science and Technology on 4 June 2014, and is valid from the Spring semester of 2015 at Karlstad University.

Course Code: FYGB09

Electromagnetic Field Theory for Engineers, 7.5 ECTS Credits
(**Elektromagnetisk fältteori för civilingenjörer, 7.5 Swedish credit points**)

Degree Level: Bachelor

Progressive Specialisation: G1F (First cycle, has less than 60 credits in first-cycle course/s as entry requirements)

Language of Instruction

Swedish or English

Prerequisites

Courses in Physics and Engineering Physics totalling 22.5 ECTS cr and Mathematics 22.5 ECTS cr. including attended course in linear algebra and vector analysis 7.5 ECTS cr. or equivalent

Major Field of Study

FYA (Physics), TKA (Engineering Physics)

Learning Outcomes

The aim of the course is that students will learn about the properties of electric and magnetic fields and to train the students' ability to apply the relevant mathematical methods.

Upon completion of the course, students should be able to:

- describe electric and magnetic fields in simple systems of point, linear, and surface charges, and linear and surface currents in terms of field lines and equipotential surfaces, as well as specify the asymptotic behavior of the fields
- give an account of the correlation between electric field intensity, electric flux density, and polarization, as well as between magnetic field intensity, magnetic flux density, and magnetization
- give an account of the concepts test charge, charge density, bound and free charges, conductivity, eddy currents
- apply the method of images to solve electrostatic problems for basic geometries and boundary conditions
- describe the behavior of electric and magnetic fields and current density at interfaces between different media
- describe the similarities and differences between an electric dipole and a magnetic dipole
- distinguish between different types of material with regard to electric and magnetic properties
- explain the meaning of the physical quantities of capacitance, resistance, mutual inductance, and self-inductance
- give an account of the concept, permittivity, permeability, electromotive force, and displacement current
- explain the function of an ideal transformer and give an account of the differences between ideal and non-ideal transformers
- give an account of Maxwell's equations, Coulomb's law, Ohm's law in point form, the Biot-Savart law, and

Faraday's law of induction, as well as the formulas for the Lorentz force and the electrical field of an arbitrary charge distribution

- describe the physical significance of the different Maxwell equations
- describe the relation between electric and magnetic fields and potential functions
- derive the wave equation from Maxwell's equations and describe its solution in the form of plane waves
- calculate the Poynting vector for plane electromagnetic waves.

Content and Form of Instruction

Instruction is in the form of lectures and calculation exercises.

The following areas are covered in the course:

Stationary electric fields and dielectric materials.

Methods of solving Laplace's equation.

Magnetic fields and magnetic materials.

Time-dependent fields and electromagnetic induction.

Maxwell's equations.

Wave equations and electromagnetic waves.

Reading List

See separate document.

Examination

Assessment is based on hand-in assignments and written exam.

Grades

One of the grades Fail (U), Pass (G), or Distinction (VG) is awarded in the examination of the course.

Engineering programme students are awarded one of the grades Fail (U), Pass (3), Some Distinction (4), or Distinction (5) in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional Information

Students who enrolled before 1 July 2007 will complete their studies in accordance with the requirements of the earlier admission. Upon completion students may request degree and course certificates to be issued under the current ordinance if they meet its requirements.

The local regulations for studies at the Bachelor's and Master's levels at Karlstad University stipulate the obligations and rights of students and staff.