Faculty of Health, Science and Technology
Physics

Syllabus

Course Approval
The syllabus was approved by the Faculty Board of Health, Science and Technology on 15 August 2014 , and is valid from the Spring semester of 2015 at Karlstad University. It replaces the former syllabus approved on 27 May 2008, Reg No FAK2 2008/9:18.

Course Code: FYGB03
Electromagnetic Field Theory, 7.5 ECTS Credits
(Elektromagnetisk fältteori, 7.5 Swedish credit points)
Degree Level: Bachelor
Progressive Specialisation: G2F (First cycle, has at least 60 credits in first-cycle course/s as entry requirements)

Language of Instruction
Swedish or English

Prerequisites
Physics, 30 ECTS Credits, and matehmatics, 30 ECTS Credits, or the equivalent.

Major Field of Study
FYA (Physics)

Learning Outcomes

The aim of the course is that students will get familiar with 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 charge, and linear- and surface current in terms of field lines and equipotential surfaces, as well as specify the asymptomatic 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 methods of images and separation of variables to solve electrostatic problems for basic geometries and boundary conditions
- describe the behavior of electric and magnetic fields and current density in interfaces between different media
- describe the similarities and differences between an electric dipole and magnetic dipole
- give an account of how materials are classified on the basis of electrical properties (insulator, conductor, semiconductor, superconductor) and magnetic properties (dia-, para-, ferro-, and antiferromagnetism), and describe the hysteresis effect
- recount the definition of the physical quantities of capacitance, resistance, mutual inductance, and self-inductance, and specify the behavior of capacitance and resistance in parallel and serial connection of capacitors and resistors

- give an account of the concepts susceptibility, permittivity, permeability, electromotive force, and displacement current
- explain the functioning of an ideal transformer and give an account of the differences between ideal and non-ideal transformers
- recount 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
- explain the physical significance of the different equations of Maxwell
- describe the relation between electric and magnetic fields and potential functions
- derive the wave equation for potential from Maxwell's equations
- explain the difference between phase velocity and group velocity
- 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 program me 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 course FYGB03 cannot be included in the same degree programme as the course FYGB09.

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.

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