EI1220 Electromagnetic Theory E 10.5 credits

Teoretisk elektroteknik E

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

The official course syllabus is valid from the autumn semester 2024 in accordance with the decision from the director of first and second cycle education: J-2024-0727.Decision date: 2024-04-15

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

Knowledge in algebra and geometry, 7,5 credits, equivalent to completed course SF1624.

Knowledge in one variable calculus, 7,5 credits, equivalent to completed course SF1625.

Knowledge in multivariable analysis, 7,5 credits, equivalent to completed course SF1626.

Knowledge in electrical circuit analysis, 5 credits, equivalent to completed course EI1110, or knowledge in electrical circuit analysis, equivalent to TEN2 in EI1110, or knowledge in basic electromagnetism, 7,5 credits, equivalent to completed course SK1115.

Knowledge in vector calculus equivalent to active participation in ED1110/SI1146.

Active participation in a course offering where the final examination is not yet reported in LADOK is considered equivalent to completion of the course.
Registering for a course is counted as active participation.
The term 'final examination' encompasses both the regular examination and the first re-examination.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course, the student shall from a description of an electromagnetic problem be able to

- solve electrostatic problems by choosing correct method, analyse the problem with correctly applied theory and mathematical tools (vector algebra, integral calculus, approximations), to obtain and present correct results, and evaluate the plausability of the results.
- solve magnetostatic problems and induction problems by choosing correct method, analyse the problem with correctly applied theory and mathematical tools (vector algebra, integral calculus, approximations), to obtain and present correct results, and evaluate the plausability of the results.
- solve electrodynamic problems by choosing correct method analyse the problem with correctly applied theory and mathematical tools (vector algebra, integral calculus, approximations, the complex method), to obtain and present correct results, and evaluate the plausability of the results.

Note that ’solve problems’ in all three intended learning outcomes above means also that based on an appropriate part of Maxwell's equations by means of vector calculus, integral calculus and differential calculus be able to show how known expressions in the electromagnetism are related to one another. For example, Gauss law on integral form should be able to be derived based on the differential equation.

Course contents

Electrostatics:

- Coulomb's law; the electric field E; charge distributions; Gauss law, where fields are defined based on their force, calculate fields from given charge distriubutions
- the scalar potential; electrostatic energy; conductors; capacitance,
- method of images, for boundary value problems;

- the electric dipole; polarisation; bound charges; The D-field; dielectrics; permittivity, the interaction of the electric field with material;
- current density; conductivity; resistance; Joule's law.

Magnetostatics and induction:

- Biot-Savart's law; the magnetic field B; the continuity equation; Ampère's law; the vector potential, the B-field defined from its force; calculate magnetic fields from a given stationary current density;
- the magnetic dipole; magnetisation; bound current density; The H-field; permeability; magnetic field interaction with materials;
- electromotive force; the induction law; inductance; magnetic energy.

Electrodynamics:

- Maxwell's equations; the Poynting theorem for energy transport;
- the wave equation; plane waves; complex fields; plane waves in materials; reflection and transmission, normal incidence against dielectrics and oblique incidence against metal;
- the electric and magnetic elementary dipole antennas.

Examination

- TEND - Partial exam, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- TENE - Partial exam, 3.5 credits, grading scale: A, B, C, D, E, FX, F
- TENM - Partial exam, 4.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

TENE, TENM can be examined partly separately during the course and partly together with TEND in the examination period at the end of the course. TEND is also examined separately in the reexamination period.

Transitional regulations

For students who have not completed EI1220 before period 4 in 2019, KONE, KONM, TEN1 are translated to TENE, TENM or TEND.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.

- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.