



# El1221 Electromagnetic Theory E, optional course 4.5 credits

Teoretisk elektroteknik E, påbyggnadskurs

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

## Establishment

Course syllabus for El1221 valid from Autumn 2014

## Grading scale

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

## Education cycle

First cycle

## Main field of study

Technology

## Specific prerequisites

Electromagnetic theory, corresponding to El220.

## Language of instruction

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

# Intended learning outcomes

## General goals

After the course the student shall from a description of a situation that leads to an electromagnetic field problems be able to

- use their conceptual understanding of the electromagnetic laws in order to qualitatively describe the behavior of the solution to the problem
- use their ability to manage the electromagnetic laws to, in simple situations, set up a computational model and perform the necessary calculations: select appropriate methods; make appropriate approximations; plausibility assess the results

## Concrete goals

- calculate the forces and torques by conservation laws for energy, momentum and angular momentum
- analyze the polarization state of an electromagnetic wave
- analyze refraction and interference of electromagnetic waves by reflection from interfaces
- explain the basic concepts of transmission lines and calculate currents and voltages along a transmission line
- use the Smith chart for solving matching problems
- analyze wave propagation in rectangular waveguides
- distinguish between near-field and far-field properties
- calculate the radiation field from straight wire antennas with given current distributions
- calculate the radiation field from antenna arrays without coupling between the elements
- explain the concepts of radiation pattern and radiation resistance
- describe the concepts of directivity, antenna gain and beamwidth

## Course contents

- conservation laws for electromagnetic momentum and angular momentum
- methods for force calculations: virtual work; Maxwell stress tensor
- plane waves: reflection and transmission at oblique incidence; critical angle; Brewster angle
- transmission line theory: distributed parameters, characteristic impedance; matching; Smith chart
- fields from general source distributions
- basics of antenna arrays and wire antennas; radiation pattern; radiation resistance; antenna demonstration

## Disposition

Lectures and tutorial exercises.

## Examination

- TEN1 - Written Exam, 4.5 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.

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

## Other requirements for final grade

Passed in all examination moments.

## 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.