KTH Electrical Engineering

EI2420 Electromagnetic Wave Propagation

spring 2013; 7,5 credits

Department

Electromagnetic Engineering, School of Electrical Engineering, Teknikringen 33.

Course responsible, lecturer and examiner

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Course information on the web

Current information about the course can be found on:
`https://www.kth.se/social/course/EI2420/`

Aim

In addition to the introductory courses, this course provides consolidated and enlarged knowledge about electromagnetic field theory, regarding physical understanding and mathematical skill in solving field problems.
After completion of the course the student shall be able to

- Use Greens function for integral representations of electromagnetic field in external and internal regions of arbitrary shape.
- Explain estimates and approximations when using integral representations for electromagnetic fields. Relate fields to sources
- Choose method to solve an integral equation in some typical cases.
- Use the equivalence principle for currents to represent electromagnetic fields
- To construct approximation and to motivate them when solving the fields from a reflector antenna.
- Numerical calculate current distribution, scattering and/or reflection and transmission coefficient for three standard cases: wire antenna, coated sphere, reflector antenna.
- Represent the radiating field with the electromagnetic multipoles.
- Know and use the approximations of Geometric optics and Physical optics
- Calculate the radar cross section
- Solve problems with the zero field method, and to have knowledge of the T-matrix, and to use the properties of the T-matrix
- Derive the integral equations in time domain. Be aware of the similarities and differences of integral equations in transient and time harmonic cases.
- Write detailed reports with motivations for calculations and explanations of simulation results.

Prerequisites

- Introductory courses in electromagnetic theory, including vector analysis.
- Field Theory for Guided Waves (EI2410) and Applied Antenna Theory, is recommended
- Courses about mathematical methods in physics and functions of complex variables. (Like SI1141, SF1628)
- Familiarity with numerical softwares, like Matlab and Maple.

Course material

Jonsson & Ström: Electromagnetic Wave propagation and scattering, 150 pages. Edition 2013. The material can be bought at class, or one of the subsequent classes. Price 200 SEK.

Requirements

Three homework problem and one written examination. Homework problems, *handed in before deadline*, each will be graded with 0-100 points.
In addition there are exercises in the manuscript; each such exercise is worth 2 points, a selection of them will be graded, deadlines are given from class to class. – Which problems that belong to a class will appear on the course web-page. The exercises can be handed in before class or in the postbox marked EI2420 at the entrance of Teknikringen 33 or at the start of the class.
On request, the student should be able to explain a homework problem or exercise to the lecturer/other students.
The exam take place in week 11 in March, place and time will be determined to allow for mixed schedules.
The points on exercises and homework problem contributes to passing the exam in the following way:

Grade	Scale
E	250 points
D	350 points
A-F	Exam

The lectures take place at Teknikringen 33, 1 stair, in the rooms 'Seminarierummet' or in 'Lilla' or 'Stora Konferensrummet'.

Homework Problems

There will be three rounds with homework problems. Each assignment is typically a smaller design task or a deeper exploration of some result that has been derived at the lectures. Both mathematical and numerical analysis will be needed.
The reports shall be written using a word-processor, e.g. LaTeX, Word or similar and disposed as follows:

- Describe your analysis, using a minimum number of equations. Refer to the course literature, when appropriate.
- Give a brief description about the numerical treatment and append listings of your programs. Comment on the figures and tables that have been inserted into the text.
- Attach your numerical code.

The reports shall be emailed to `ljonsson@kth.se` at the end of the day in according to the table in below. The grading of an assignment will be based on the degrees of activity, creativity and understanding, as they appear from the report. The works is to be an individual work.

Homework Problem	**1**	**2**	**3**
Handed out	28 Jan	8 Feb	22 Feb
Deadline for handing in	7 Feb	21 Feb	6 Mar

Written examination

The exam take place week 11 of March date and time and place will be determined in class no later than 4:th of March.