Midterm Project
TFY4240 Electromagnetic Theory
Fall 2010

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1 Introduction

This document is intended to give you some general information for the midterm project. The midterm project will consist of two problem sets. The first will be given during the start of the semester. You are required to hand in a report describing your work towards the end of the semester, which should cover both problem sets (details below). You are also required to hand in your programming code, as well as your LaTeX code.

2 Rules and Regulations

You should hand in individual reports. You are, however, allowed to discuss the project with absolutely anyone, including fellow students, professors, and your mother. If you find useful resources on the web, in an article, or a book, just cite them in your references. In this sense, you have full freedom as in a "real" job situation.

You are not allowed to copy code or reports written by your fellow students, or articles on the web. You are not allowed to "invent" results or data, or borrow plots from other people. You are of course allowed to find theory and inspiration elsewhere, just remember to cite your findings in the bibliography, and credit the original author. In this sense, you are expected to do your own research, much as real-world researchers do.

With regard to software, programming languages and algorithms, you are free to use the tools of your choice. The lecturer and student assistants cannot, however, be expected to master the details of all programming languages and plotting programs. You will, of course, be given help in all aspects of your project. If you choose our "recommended software", we should be able to answer programming questions, too.

3 Recommended tools

You are *required* to use LaTeX for your report writing.

For numerical work and plotting, you may use any tools available to you. I recommend you to use the programming language `python`, with the libraries `numpy`, `scipy`, and `matplotlib`. `python` is a scripted language, with some interesting properties:

- It is typically slower than e.g. C and FORTRAN, but often fast enough
- Creating a small script to automate tasks is easy
- Development is faster: you just save your file and run, instead of saving, compiling, debugging, recompiling, and running.
- `python` code is typically shorter than the equivalent C/C++/Java code, meaning less code to get right.
- `python` modules exist for a lot of tasks.

`python` and its libraries are free and open source, meaning that you are free to read and modify the source code. This makes debugging easier. It also gives you a great opportunity to learn programming by studying other people's code. As a bonus, the purchasing cost is 0.

We will put links to recommended examples and tutorials on the course homepage.

If you choose some other programming language and / or plotting program, remember the following:

- Plotting programs must be able to produce vector graphics output. In practice, this is EPS or PDF (EPS for the `latex` compiler, and PDF for the `pdflatex` compiler). I would recommend using PDF figures and the `pdflatex` compiler.
- You will need numerical integration routines (write yourself or use libraries)

As a main physics reference for the project, I suggest simply using our standard textbook [1]. Another good reference is Ref. [2].

4 Report requirements

The report must fulfill the following requirements to obtain the full 20 point score:

Pass / fail It must be written in LaTeX.

3 points It must contain all the standard parts: (brief) introduction, theory, results, discussion / conclusion, and references. The theory chapter should assume that the reader knows everything in Griffiths and the assignment text, and simply explain what you have done analytically and in your program. The results should include your plots and explain, with reference to the theory, why the result is reasonable (or why it is not!). If you make any choices (such as numerical values of constants), give these in the text as well.

3 points References, figures, tables and so on should be "as usual" for e.g. a lab report or article. Figures must be in a vector format (e.g. EPS or PDF), to avoid ugly bitmap artifacts such as jpg compression.

7 points Reasonably good results on all parts of the first problem. To obtain partial credit, any discrepancies and errors must be duly commented and discussed.

7 points Reasonably good results on all parts of the second problem. To obtain partial credit, any discrepancies and errors must be duly commented and discussed.

5 Grading

The numerics project will count 20% towards your final grade in this course. You will, however, be allowed to take the final exam without doing the numerics report.[1] Note that according to NTNU regulations, you will have to pass the final exam to complete the course, meaning you have to get a 40% total score on your final exam to pass the course no matter how good your midterm project is.

You will be graded based solely on your report. The mid-term grade will count 20% towards your total grade, and the final exam will count 80%. If your final report contains all requested parts, with decent results, you will be awarded the full 20% score. It is our intention that hard work will be rewarded!

[1] This will, of course, limit your exam result to the grade C or worse.

References

[1] David J. Griffiths. *Introduction to Electrodynamics*. Pearson Benjamin Cummings, 3rd edition, 1999.

[2] J. D. Jackson. *Classical Electrodynamics*. John Wiley, 3rd edition, 1998.