PHSX 566: Mathematical Physics I

Fall, 2016

Instructor:	Charles Kankelborg
Text:	*Mathematical Methods for Physics and Engineering* by Riley, Hobson and Bence (Cambridge, 3rd ed.)
Lectures:	M W F 12:00-12:50 am, AJM Johnson 238
Office:	EPS 260C, x7853
Office hours:	Per posted schedule, or by appointment
Grader:	Kevin Thoelecke

Description

In this course, we will encounter a selection of mathematical methods applicable to physics. A common synonym is theoretical physics, but I am primarily an experimentalist. It should not surprise you that mathematical physics is essential to experiment design and data analysis. The character of the text is more practical than formal, and it is quite readable.

We will not cover the entire text. Instead we will focus on a short list of topics, explore their connections, and spend enough time in each area to develop confidence.

Grading

Homework assignments, worth 10 points each, will be due *in class* every week. Late homework will be assessed a 1 point penalty per day. The remainder of the grade will be determined by the midterm and final exams, worth 50 and 100 points, respectively. The midterm will be in class, date TBD. The final exam is scheduled for *Thursday, December 15, 2016, 4:00-5:50 PM in our classroom.*

Useful references

The following materials will be placed on reserve in the Library.

- Bracewell, *The Fourier Transform and its Applications*
- Arfken & Weber, *Mathematical Methods for Physicists*
- Gradshteyn & Ryzhik, *Table of Integrals, Series, and Products*

In addition, the following is available electronically:

- Abramowitz & Stegun, *Handbook of Mathematical Functions*, `http://people.math.sfu.ca/~cbm/aands/`

Course Outline

The following list of topics is tentative. The lecture notes cover some topics that we won't hit in class; please feel free to browse for things that might be useful to you.

1. Fourier transforms (ch. 13)
2. Green's function solution of ODEs (§15.2)
3. Eigenfunction approach to ODEs (ch. 17)
   (a) Dirac notation, orthonormal bases, Hermitian operators (§§17.0-17.3)
   (b) Green's functions (§17.5)
   (c) Sturm-Liouville equations and special functions (§17.4)
4. Partial Differential Equations (chs. 20-21)
   (a) Common physics PDEs (§20.1)
   (b) Separation of variables, special functions (§§21.1-21.3)
   (c) Integral transform methods (§21.4)
   (d) Eigenfunctions and propagators (not in text)
   (e) Green's functions for inhomogeneous PDEs (§21.5)
5. Complex analysis (ch. 24)
   (a) Analytic functions (§§24.1-24.6)
   (b) Application: Kutta-Joukowsky theorem (CCK notes, §39)
   (c) Integrals and residue theory (§§24.8-24.13)