PHSX 566: Mathematical Physics I
Fall, 2018

Instructor: Charles Kankelborg
Text: *Mathematical Methods for Physics and Engineering*
by Riley, Hobson and Bence (Cambridge, 3rd ed.)
Lectures: MWF 12:00-12:50 am, Roberts 307
Office: EPS 260C, x7853
Office hours: Per posted schedule, or by appointment
Grader: Sourav Sen Choudhury

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 representative 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 at 4:30 pm in your grader’s mailbox (not mine) every Monday. Late homework will be assessed a 1 point penalty. Late homework will not be accepted after the Monday of finals week. The remainder of your grade will be determined by the midterm and final exams, worth 50 and 100 points, respectively. There will be one midterm exam, date TBD. The final exam is scheduled for Monday, December 10, 2018, 8:00-9:50 AM in our classroom.

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

- Bracewell, *The Fourier Transform and its Applications*
- Gradshteyn & Ryzhik, *Table of Integrals, Series, and Products*

In addition, the following are available electronically:

- Abramowitz & Stegun, *Handbook of Mathematical Functions*,
Course Outline
The following list of topics is tentative. The lecture notes provided online cover some topics that we won’t hit in class; please feel free to browse for things that might be useful to you.

1. 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)

2. Fourier transforms (ch. 13)

3. Green’s function solution of ODEs (§15.2)

4. 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)

5. 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)