

Physics 485 – Methods of Mathematical Physics – Spring 2003

Tuesdays, Thursdays 9:30-10:45 in Faraday West 227

Dr. S. Martin Faraday West 214 (815) 753-6467 spmartin@niu.edu

office hours: M,T,W 10:45-11:45 (or anytime you can find me)

Home page: <http://zippy.physics.niu.edu/phys485.html>

Textbook: There is no official textbook for this class. However, I strongly recommend you obtain one of the following:

Mathematical Methods in the Physical Sciences by M.L. Boas, 2nd edition, Wiley, ISBN 0471044091.

Pros: Much more clearly written and logically organized than Arfken+Weber. Students often find the examples easier to follow.

Cons: Not nearly as complete as Arfken+Weber. Does not have a few of the topics we will cover.

Mathematical Methods for Physicists by G.B. Arfken, H. Weber, 5th edition, Harcourt/Academic Press, ISBN 0120598256.

Pros: Much more complete than Boas. A useful reference for work outside of our course. Some copies are available in the bookstore.

Cons: Organized in a way that is sometimes confusing. Examples are sometimes lacking.

Grading:

50% Homework (Late penalty policy: 10% off for each day after the due date, for up to 1 week; 90% for > 1 week.)

20% Midterm Exam: Date TBA

30% Final Exam: Thursday, May 8, 10:00 a.m.

To pass this course, you must score at least 50% on the homework and also 50% overall.

Please feel free to ask questions in or out of class. You are encouraged to consult with each other and/or with outside sources on the homework. However, do not turn in anything that you have simply copied, or anything that you do not truly understand. Exam questions will be similar to homework questions.

Topics to be covered:

- Infinite Series (Boas Chapter 1, 11.12; Arfken 5.1-5.9)
 - Convergence tests; absolute vs. conditional convergence
 - Taylor and Maclaurin series
 - Some special series
 - Algebra of series
 - Using series to find limits
 - Improvement of convergence
 - Inversion of series
 - Elliptic integrals
- Gamma functions and Beta functions (Boas 11.1-11.7; Arfken 10)

- Asymptotic series (Boas 11.9-11.11; Arfken 5.10-5.11)
 - Stirling's formula for the Gamma function
 - Error function
 - Incomplete Gamma function
- 1st-order Ordinary Differential Equations [ODEs] (Boas 8.1-8.4; Arfken 8.2)
 - Separable
 - Linear
 - Exact
- 2nd-order ODEs with constant coefficients (Boas 8.5-8.6; not in Arfken)
 - Homogeneous
 - Non-homogeneous
- 2nd-order ODEs with non-constant coefficients (Boas 12; Arfken 8.3-8.5, 11, 12, 13, 9)
 - Legendre and associated Legendre functions
 - Spherical harmonics
 - The method of Frobenius
 - Bessel, Neumann, Hankel, Modified Bessel, spherical Bessel functions
 - Hermite polynomials
 - Laguerre and associated Laguerre polynomials
 - Hypergeometric and confluent hypergeometric functions
 - Sturm-Liouville theory
- Numerical methods for ODEs (not in Boas; Arfken 8.8)
 - Euler method
 - 2nd-order Runge-Kutta
 - 4th-order Runge-Kutta
- Critical points, non-linear ODEs, solitons, chaos theory (not in Boas; Arfken 18)
 - As time permits!