Physics 350/450 — Mathematical Methods of Physics II
Spring 2003

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Office Hours: TBD.

Nominal Text: Arfken & Weber, *Mathematical Methods for Physcisists*, fifth edition.

Abramowitz and Stegun, *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables* will be very useful (available from amazon.com).

Other References:

Mathews and Walker, *Mathematical Methods of Physics*
Morse and Feshbach, *Methods of Theoretical Physics*
Gradstein and Ryzhik, *Table of Integrals, Series, and Products.*

Course Requirements:

Problem sets:	30%
Tests (2):	25%
Paper/project/class lecture	20%
Final exam:	25%

Problem Sets: Problems sets are a required part of the course. They will be due in roughly 2 week intervals. You are encouraged to work together, however each student must write up their own solutions. Some problems will require the solutions from numerical programs. Familiarity with C, C++, Maple, Mathematica, ... is assumed. If this is a problem let me know.

Tests: There will be two tests and a final. The format of the tests (in class/take home) is yet to be determined. For the two tests, the higher graded one will count for 15% and the other will count for 10%.

Phys350 Students: A paper/project is required. It can be on any topic in mathematical physics that is mutually agreeable. It must be done independently. Written abstracts are due Wednesday, March 5. It should be no longer than 1 page but should make clear the topics that will be covered. The paper/project need not (even should not) be original research. It can be a synthesis of literature, however it should not be a paraphrasing of a single source. For a traditional paper it should be approximately 10–15 pages, double spaced with 1 inch margins in 12 pt type. Spelling, grammar, and punctuation will count heavily in the grading. The paper should be organized and typeset in a consistent manner (including references and equations). See journals such as *The Astrophysical Journal* and *Physical Review Letter* for possible styles. If you have and idea for a different type of project discuss the details with me. The paper/project is due Monday, April 14. I will read and comment on any drafts if they are given to me by April 7. Late abstracts or papers will result in a 1 letter grade reduction.

Phys450 Students: You will be required to prepare and teach on or two classes on an aspect of group theory (more details will be provided later). This involved preparing and delivering the lecture as well as preparing homework problems and solutions. The homework problems will be part of the problem set for the rest of the class. This will occur sometime in early to mid April.

Tentative List of Topics

The order and content is subject to change.

Coordinate Systems: General features of coordinate systems.

- General orthogonal coordinates. Surface area element, volume element, gradient, divergence, curl, Laplacian.
- Examples: Cartesian, cylindrical, spherical, ...

Special Functions and Separable PDE Common partial differential equations and their relations to special functions.

- Poisson equation, Helmholtz equation, wave equation, heat/diffusion equation.
- General properties of special functions: differential equation, generating function, integral relations, series form, asymptotic series, recursion relations
- Special functions: Bessel functions, Legendre polynomials, Spherical harmonics
- Other polynomials: Chebyshev, Laguerre, Hermite, Jacobi, Gegenbauer
- Hypergeometric and Confluent Hypergeometric series

Other interesting functions Bernoulli and Euler polynomials, Reimann Zeta function, Euler-Maclaurian formula and series.

Tensors and differential geometry Euclidean and non-euclidian tensors. Four vectors. Antisymmetric tensors and their relationship to differential forms.

Additional Topics Based on interest and time any of the following topics may be covered.

- Integral equations
- Partial differential equations
- Groups and group representations
- Vectors and matrices
- Numerical techniques