Physics 228: Elementary Mathematical Physics (part 2 of 2)

Based on W13-15 as taught by Steve Sharpe.

Overview

This course introduces the mathematical tools needed for advanced undergraduate and beginning graduate physics classes. The emphasis is on problem solving rather than on rigorous proofs. There are 4 lectures per week, plus a Mathematica and problem-solving tutorial. Basic use of a computer mathematics program such as Mathematica is now an integral part of this course and its discussion might be included in the lectures.

Evaluation

Weekly written quizzes, two midterms and one final exam. Weekly homeworks are assigned but not graded.

Texts

1. **Required:** *Mathematical Methods in the Physical Sciences*, Mary L. Boas (Wiley, 3rd ed., 2006)

Topics (approximate; chapters refer to Boas)

1. **Ch. 8 (4 lectures):** First-order linear ordinary differential equations (ODEs); Second order ODEs with constant coefficients.
2. **Ch. 14 (5 lectures)** Analytic functions, Cauchy-Riemann conditions; Complex contour integrals & Cauchy's theorems; Method of residues & applications; Laurent series.
3. **Ch. 8 again (6 lectures)**: Laplace transforms; Inverse Laplace transforms; Dirac delta function & appications to ODEs; Green functions & applications; Solving ODEs by matching.
4. **Ch. 9 (3 lectures):** Calculus of variations; Lagrangian mechanics.
5. **Ch. 12 (5 lectures):** Series solutions to ODEs; Legendre's equation; Generating functions; Legendre polynomials & applications; Legendre Series; Fuch's theorem & Frobenius' method for solving ODEs.
6. **Ch. 11 (1 lecture):** Gamma and Beta functions.
7. **Ch. 12 again (1 lecture):** Bessel's equation and it's solutions.
8. **Ch. 13 (6 lectures):** Introduction to partial differential equations (PDEs); Separation of variables; Laplace's equation in 2-d with Cartesian coordinates; Diffusion equation with Cartesian coordinates; Curvilinear coordinates in general (**Ch. 10**); PDEs in cylindrical coordinates; PDEs in spherical coordinates & applications.
9. **Ch. 14 again (1 lecture):** conformal maps & applications.
10. **Review (2 lectures)**