Phys 651 Spring 2016

In this section of the course the basic mathematical tools needed to pursue research in Physics are presented. The first half of the semester is spent on a reworking and review of material likely (but not neccesarilly) to have seen before. This material is presented in a manner tailored to its application in Mathematical Physics. In the second half of the semester is devoted to the analysis of the ordinary differential equations which arise is Physics and to their solutions (the so-called special functions).

There will be weekly homework assignments, two midterm exams, and a final exam. The sections of the course are as follows.

Linear algebra:

- Vector spaces
- Linear independance
- Inner products
- Matrices
- Invertibility and the determinant

Calculus of several variables:

- The derivative matrix
- Change of variables and the chain rule
- Taylor expansion
- Integration
- Stoke's theorem
- Dirac delta function

Complex analysis:

- Functions on the complex plane
- Analyticity
- Integration over curves
- Cauchy's theorem
- Laurent expansion
- The calculus of residues

Linear ordinary differential equations :

- Initial value problems at regular points
- Second order equations
- Reduction of order
- Power series expansion
- Airy functions

Regular singular points
Indicial equation analysis and classification of solutions
Bessel functions
Spherical Bessel functions
Asymptotic analysis
Applications: radiation from spherical and cylindrical sources

Boundary value problems :

Linear boundary conditions for second order equations
Homogeneous versus inhomogeneous boundary conditions
Eigenfunctions of a differential operator
Application: vibrations of a circular membrane

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Office hours by appointment