Partial Differential Equations, Math 436, Fall 1996

Instructor: Mark Alber

Text: Mark A. Pinsky, Partial Differential Equations and Boundary-Value Problems with Applications, Second Addition, McGraw-Hill.

Syllabus:

1. Short review of ODE's and dynamical systems

2. Examples of PDE's with applications. Mathematical modeling. Linear second-order PDE's of hyperbolic, elliptic and parabolic type. Laplace's equation, Wave equation, Heat equation, Telegraph equation, Poisson equation.

3. Initial and boundary conditions. Method of separation of variables.

5. Functional series: power series, Taylor series and Furier series. Uniform confergense.

6. Sturm-Liouville eigenvalue and eigenfunction problem. Orthogonal complete sets of functions. Bessel's inequality.

7. The Fourier theorem. Generalized Fourier Series. Gibb's phenomenon. Double Fourier Series. Fourier series in cylindrical and spherical coordinates. Poisson integral formula.

8. Vibrating string. Fundamental frequencies and harmonics. Resonance.

9. The d'Alembert solution.

10. Fourier series method for the Heat, Wave and Laplace equations.

11. Fourier transform. Application to the the Heat and Wave equations.

12. Laplace transform. The complex inversion integral.

13. Generalized functions. Delta function.

14. Green's function for ODE's. Green's function for PDE's.

15. Nonlinear integrable PDE's and Inverse Scattering Transform (IST) method. Periodic and soliton solutions of the KdV equation.

16. Shock solutions of the nonlinear PDE's.

17. Numerical methods for PDE's.