Math 395 Nonlinear Partial Differential Equations (Fall 2013)

This course covers mathematical theories and numerical methods for nonlinear partial differential equations, as well as their physical applications in areas including water waves and nonlinear optics.

Topics include:

1. Linear wave equations; dispersion; group velocity;
2. Derivation of some nonlinear partial differential equations including the Korteweg-de Vries Equation (KdV) equation and the nonlinear Schroedinger (NLS) equation in water waves and nonlinear optics;
4. The inverse scattering transform method;
5. Solitons; soliton collisions; N-soliton solutions;
6. The soliton perturbation theory and applications to nonlinear optics;
7. Solitary waves in nonintegrable equations;
8. Linear stability theory of solitary waves; Vakhitov-Kolokolov stability criterion;
9. Weak interactions of solitary waves;
10. Transverse instability of line solitary waves;
11. The (2+1)D nonlinear Schroedinger equation; the virial theorem; critical collapse.

Pre-requisites: elementary knowledge of linear ODEs and PDEs (Math 230, Math 339 or equivalents) and numerical analysis (Math 237 or equivalent).