Advanced Numerical Methods for Partial Differential Equations

Department: MATH
Course Number: 6641
Hours - Lecture: 3
Hours - Lab: 0
Hours - Recitation: 0
Hours - Total Credit: 3
Typical Scheduling: Every even spring
Description:
Analysis and implementation of numerical methods for nonlinear partial differential equations including elliptic, hyperbolic, and/or parabolic pr
Prerequisites:

Math 6640

Course Text:

No text

Topic Outline:

Error Analysis and Convergence of Numerical Methods for Elliptic and Parabolic Problems - Norms and function spaces, regularity, stability, implicit and explicit methods, Gronwall arguments, a priori convergence estimates, preservation of dissipativity and invariance under discretization
Error Analysis and Convergence of Numerical Methods for Conservation Laws - Existence and uniqueness of solutions, characteristics, stability, upwinding, shock tracking, shock capturing, Euler and Lagrange coordinates, approximation of characteristics, streamline diffusion, regularization and numerical dissipativity, order of convergence and regularity of solutions, compensated compactness
Adaptive Error Control - A posteriori estimates, residual errors, stability and propagation of error, mesh refinement and stepsize selection efficient computation
Miscellaneous Topics as Time Permits - Multilevel methods, solving nonlinear systems of equations