

Topic Outline for Math 517 @ISU

I. Problems with Periodic data

High order of accuracy

- Efficiency of high order methods

Fourier Series and Trigonometric interpolation

- Recall Fourier series theory
- periodic grid function
- difference operators
- trigonometric interpolation.

Model equations

- First order wave equation, convergence, stability
- Ideas of adding numerical viscosity, upwind scheme, implicit
- The leap-frog scheme
- The implicit method
- truncation error
- heat equation
- convection-diffusion equation
- high-order equations
- Generalization to several space dimensions

Well-posedness problems

- Scalar differential equations with constant coefficients
- First order system with constant coefficients
- Parabolic system with constant coefficients
- General systems of constant coefficients
- Semi-bounded operator with variable coefficients
- The Duhamel principle
- Well-posedness of nonlinear problems.

Stability and convergence for numerical approximations of linear and nonlinear problems

- Stability and convergence
- Stability for approximations with constant coefficients
- The energy method: approximation with variable coefficients
- Splitting methods
- Stability for nonlinear problems