ACMS / MATH 60790: Numerical Analysis II
Spring 2016 Syllabus

Instructor: Martina Bukač, e-mail: mbukac@nd.edu

Class time and location: MWF 2:00 pm - 2:50 pm, Pasquerilla Center 109

Textbooks:

> J.W. Thomas, Numerical Partial Differential Equations: Finite Difference Methods, Spring.

> Zhangxin Chen, Finite element methods and their applications, Springer

Prerequisites: The course requires a moderate amount of programming. FORTRAN or C or C++ programming languages are preferred. However, students may also use software programs including Matlab, Mathematica.

Course Description: This course is the second part of a two semester sequence of numerical analysis courses. It is an introductory graduate level course designed to introduce mathematics, engineering, and science students the fundamental concepts in numerical methods for solving partial differential equations and theoretical analysis. This is a three credit course.

Main Topics:

1. Elliptic problems - Laplace and Poisson equations. Parabolic problems - diffusion or convection-diffusion equations.
2. Finite element method basics: variational formulation, interpolation theory, quadrature, energy norm, a priori convergence, order of convergence.
3. Finite difference method basics: convergence, stability and consistency, von Neumann stability analysis and Fourier transforms. Methods of lines - time discretization schemes (explicit, implicit methods etc). Numerical methods for solving high order nonlinear equations.
4. Hyperbolic problems - wave equation, nonlinear hyperbolic conservation laws, method of characteristics, stability, the CFL condition, convergence.
5. Miscellaneous topics as time permits - Iterative methods for solving system of linear equations. Finite volume method basics: LF, LW, TVD, MUSCL, ENO/WENO. Discontinuous Galerkin finite element method for convection-dominant problems.

Grading scheme:
Course grades will be based on homework and projects.
Homework and Project: 70%
Final project: 30%

Attendance: You are expected to attend every class including your assigned tutorials. Excessive absences may result in lowering your grade and even failing the course.

Honor Code: As a member of the Notre Dame community, I will not tolerate academic dishonesty. All examinations, homework and computer projects are conducted under the Honor Code. You are encouraged to work together on the homework assignments and projects, but copying in any form or submitting work done by others as your own is a violation of the Honor Code. Examinations are closed book and are to be done completely by yourself.