AMS-528: Numerical Analysis III
Numerical Analysis of Partial Differential Equations

Spring 2019 Syllabus

Instructor: Roman Samulyak

Office: Math Tower 1-108
Office Phone: (631) 632-8353
Email: roman.samulyak@stonybrook.edu

Office Hours: 9:00 - 10:00 am  Mondays and Fridays or by appointment in Math 1-108

Home Page: http://www.ams.sunysb.edu/~rosamu

TA: Shaohua Yuan

Office hours: Tuesdays, 12:00 – 2:00 in Harriman 132
Email: Shaohua.Yuan@stonybrook.edu

Class Hours: 1:00 - 2:20pm, Mondays and Fridays in Chemistry 128

(2) R. Leveque Numerical Methods for Conservation Laws (required)

Attendance: All students are required to attend all classes and all exams.

Course Description: The main goal of this course is to introduce student to scientific computing and present basic and some advanced numerical techniques for solving partial differential equations that have numerous applications in fundamental and engineering sciences. The emphasis is given on finite difference and finite volume methods. Finite difference methods are covered for the three major classes of partial differential equations: parabolic, elliptic, and hyperbolic. A brief introduction to
meshless and particle methods for PDE's will also be given. Practical implementation will be discussed as well as the use of important packages of scientific software algorithms. Several last lectures will have a seminar form - some recent advances in numerical methods for PDE's will be discussed.

- Introduction to numerical methods for PDE
- Consistency, convergence and stability, Lax theorem
- Hyperbolic equations, numerical schemes, stability analysis and CFL condition
- Parabolic equations, implicit schemes, convection diffusion equations
- Two dimensional problems, alternate directional implicit (ADI)
- Elliptic equations, discretization methods for irregular domains
- Numerical dispersion and numerical dissipation
- Conservative schemes, Lax-Wendroff theorem
- Godunov scheme, approximate Riemann solvers
- Nonlinear stability
- High-order conservative schemes for hyperbolic PDE's, limiters
- ENO and WENO schemes
- Particle and Particle-Mesh methods
- Numerical methods for multiphase systems
- Domain decomposition methods

**Grading:**
Homework assignments: 30%
Midterm exam: 25%
Final exam: 45%

**Academic Integrity.** Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Any suspected instance of academic dishonesty will be reported to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at [http://www.stonybrook.edu/uaa/academicjudiciary/](http://www.stonybrook.edu/uaa/academicjudiciary/)

**Americans with Disabilities Act:** If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.