Instructor: Professor Fengyan Li
Amos Eaton 332, lif@rpi.edu, 276-3201

Lectures: 2:00pm-3:50pm on Tuesdays and Fridays, Carnegie 208

Office Hours: 5:00pm-6:00pm on Tuesdays and Thursdays

Textbook: Numerical Solution of Partial Differential Equations by the Finite Element Method, Claes Johnson, Dover

URL: homepages.rpi.edu/~lif/S16/Math6860_S16.html

Prerequisite: MATH/CSCI-4800 or equivalent knowledge of numerical methods; Some experience with mathematics analysis, partial differential equations, and computer programming

About the Course:

Objectives:

○ To understand the mathematics behinds finite element methods (FEMs) and discontinuous Galerkin methods (DGMs): formulations, matrices assembly for implementation, discrete spaces, approximation theory, error estimates

○ To carry out standard mathematical/numerical analysis and derivations

○ To implement and to evaluate numerical methods for some 1d and 2d problems

Contents: (Tentative topics)
Formulation, analysis, and implementation of the following methods:

○ Finite element methods for elliptic and parabolic equations

○ Mixed finite element methods for Poisson and/or Stokes equations

○ Discontinuous Galerkin (DG) methods for elliptic equations

○ Convection-diffusion equations: streamline-diffusion and DG methods

References:


3. The Finite Element Method for Elliptic Problems, Philippe G. Ciarlet, SIAM (An electronic version is available from the RPI library.)

4. Finite Element Analysis, lecture notes by Dr. Joseph E. Flaherty
http://www.cs.rpi.edu/~flaherje/FEM/index4.html

**Homework Assignments and Exams:**

**Homework:** Homework will be assigned regularly. It is expected that your report is neatly written and well organized.

  **Collaboration:** You are encouraged to discuss the problems with others and to seek assistance from online or library references. However, the work you turn in must be written by yourself and represents your own understanding on the subjects. If your work involves a teammate, or significant help from other people, reference books or papers, explicitly state this in your report to avoid penalty in grade.

  **Late policy:** No late homework is accepted. Under very special circumstances, approval might be granted for extension. Any request for extension needs to be made at least 36 hours before the deadline. Regardless of the reason, any granted extension, as long as it is not for the entire class, will result in a 10% per day reduction of the grade for the related individual.

  **Programming assignments:** Be prepared that you are expected to build some finite element codes from scratch.

**Exams:** There is one in-class midterm exam and one take-home final exam. The midterm exam will cover topics up to the exam date, and it is tentatively scheduled on March 8, 2016. The final exam will be comprehensive. Except for unforeseen reasons, one must obtain approval in advance from the instructor for missing an exam. The instructor reserves the right to change the exam date if needed.

**Mathematical Analysis and Derivation:** In both exams and homework assignments, there are questions involving mathematical/numerical analysis and derivation. Regardless of your academic disciplines, your answers to such questions should be mathematically reasonable and have as much rigor as possible in order to receive good grades. Examples of such analysis and derivation will be discussed frequently during lectures.

**Learning Outcomes and Grading:**

Your grade for this course is determined by your performance in homework assignments and exams, which are designed based on the Course Objectives.

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>50%</td>
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<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Take-home Final</td>
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Questions regarding the grading of assignments and exams can be discussed with the instructor only on the same day when the papers are returned.

**Academic Integrity:**

Student-teacher relationships are based on mutual trust. Acts that violate this trust undermine the educational process. The Rensselaer Handbook defines various forms of academic dishonesty and you should make yourself familiar with them. The penalties for cheating in this course include reduction in grade and no grade to the assignments or exams.

**Attendance Policy:** Attendance is expected.