

# **MATH 9830 Section 1: Spring 2015: Sparse Matrix Algorithms and Advanced Topics in FEM**

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**Office:** Martin O-14

**Office Hours:** by appointment (see homepage for updates).

**Prerequisites:** MATH 8600, MATH 8660

## **Course Description:**

This course is designed to introduce students to parallel numerical linear algebra topics required for efficient Finite Element computations using HPC resources and provide a rigorous framework for stabilized FEM for flow problems.

## **Topical Outline:**

1. Numerical linear algebra (sparse matrices, iterative solvers, preconditioners, multigrid methods)
2. Parallel computing in numerical methods (HPC architecture, MPI, multithreading)
3. Parallel linear algebra and parallel FEM
4. FEM analysis (incompressible flow problems, stabilized FEM)

## **Learning outcomes:**

Upon successful completion of this course, a student will be able to:

1. Understand the implications of modern HPC architecture and use them for their research.
2. Design, implement, and analyze parallel programs based on MPI and multithreading.
3. Apply knowledge about parallelization to data structures and algorithms in linear algebra.
4. Implement and use parallel finite element codes.
5. Perform finite element analysis for stabilized flow problems.

## **Attendance:**

- Class meets TTH 3:30-4:45 in Martin M204
- Students are allowed two unexcused absences during the semester. More than two unexcused absences may result in a student being dropped from the course.
- Attendance at scheduled class tests and the final exam is MANDATORY, unless prior consent has been given by the instructor. No makeup tests will be given. In the event of an "excused absence" from a test that proportion of the students final grade will be added to that of the students final exam.

- Late Policy: If the Instructor is more than 15 minutes late, the class will be considered canceled.

**Textbook:**

no required text

**Course Assessment**

Assessment for the class will be based upon homework, in class presentations, and a final write-up. Late work will not be accepted. Homework 50%, Presentation/Writeup 50%

**Grading Scale**

A = 90% - 100%, B = 80% - 89%, C = 70% - 79%,  
D = 60% - 69%, F = Below 59%.

**Course Etiquette**

All course related interactions, including in the classroom and office meetings, will be conducted in a professional manner.

- Any e-mail correspondence with the instructor must adhere to proper professional standards.
- At least 24 hours notice is required for "by appt" office hours.

**Academic Integrity**

"As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity."

Integrity Policy:

<http://gradspace.editme.com/AcademicGrievancePolicyandProcedures#integritypolicy>

**Disability Access Statement**

"It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities.

Students with disabilities requesting accommodations should make an appointment with Dr. Arlene Stewart (656-6848), Director of Disability Services, to discuss specific needs within the first month of classes.

Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Accommodations are not retroactive and new Faculty Accommodation Letters must be

presented each semester. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation."

**Title IX**

"Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The policy is located at <http://www.clemson.edu/campus-life/campus-services/access/non-discrimination-policy.html> Jerry Knighton serves as Clemson's Title IX coordinator and he may be reached at knightl@clemson.edu or 656-3181."