

## Mathematics/Computer Science 481/5465

### Numerical Analysis

**Textbook:** Scientific Computing: An introduction with Parallel Computing, 1st edition, Golub and Ortega

**Prerequisites:** MAT/CSC 381 or graduate standing

**Course Description/Learning Objectives:** In Mathematics/Computing Science 381, numerous algorithms are developed for obtaining numerical solutions to the following problems:

- Finding roots of equations - Bisection, Newton's method, Secant method.
- Approximation and Interpolation of data points - Taylor's polynomials, Lagrange polynomials, Newton's divided differences, Hermite polynomials, Cubic splines, Bezier curves
- Evaluating integrals - Riemann sums, Trapezoidal rule, Midpoint rule, Simpson's rule.
- Evaluating derivatives - Forward, Backward and Centered differences.
- Solving differential equations - Euler's method, Taylor's series methods, Runge-Kutta methods, Multi-step methods
- Solving systems of equations - Forward substitution , Backward substitution and Gauss elimination.

For these methods, careful analysis of the error in the approximation was not performed due to the mathematical rigor necessary. In Math/CSC 481, we will attempt to carefully analyze this error as well as consider additional algorithms which were beyond the scope of the prerequisite.

Further, we will look at concepts which help organize algorithms to solve the above problems in the presence of vector and parallel computing machines. The student should have taken Math/CSC 381 before enrolling for this class. The material in 381 provides motivation for the derivation and use of each of the methods mentioned above as well as practice in the implementation of each. A student may take 481 without having 381 but should be careful to spend extra effort to understand and implement concepts from 381 which may be assumed in 481.

This term (time permitting), we will investigate numerical linear algebra (roughly chapters 5-9 of the text). Some background material from earlier chapters will be discussed as needed.

**Meetings:** The format of class meetings will consist of lectures by the instructor. Student participation will be encouraged via classroom discussions as well as problem sessions where the student will present their work.

This class meets as scheduled. You are expected to be in class on time. University policy states that a student cannot miss more than 25% of class meetings and receive credit for the course. Further, attendance will be necessary in order to understand the material and make a good grade. The student is responsible for work and material missed when absent. Cheating in any way will be properly rewarded according to University policy.

If you need special accommodations due to learning, physical, psychological, or other disabilities, please contact the Counseling and Career Development Center.

**Grading:** There will be at least two examinations during the semester. Further, homework and a written review of at least three articles will be assigned. Graduate students will be graded separately and will present one paper to the class. An average of the homework and written work will count as one exam grade. These exam grades will be averaged equally to determine the final grade. The Grading scale is

A=90-100

B=80-89

C=70-79

D=65-69

F=0-64

Aim now for the desired grade. All papers will be returned to the student for keeping. In case there is any question concerning your grade, the student is expected to supply these papers.

**Grading:**

- For undergraduate students: During the semester, there will be at least two examinations. Homework as well as a library/research paper will also be assigned; together, these will be averaged as your "homework grade" and count as 20% of the final grade. Your final average will be computed by using the average of the exams with the homework grade.

A=90-100

B=80-89

C=70-79

D=65-69

F=0-64

- For graduate students: During the semester, there will be at least two examinations. Homework as well as several library/research paper will also be assigned and the student will present at least one of these papers to the class; together, these will be averaged as your "homework grade" and count as 30% of the final grade. Your final average will be computed by using the average of the exams with the homework grade.

A =90-100

B+=86-89

B =80-85

C+=76-79

C =70-75

D =65-69

F = 0-64