Numerical Analysis I

Last Updated: Mon, 01/05/2026

Course prefix: CX/Math

Course number: 4640

Section: A, BG, BU, Q

CRN (you may add up to five):
29189 30181 30182 30481

Instructor First Name: Haesun

Instructor Last Name: Park

Semester: Spring

Academic year: 2026

Course description:

This course introduces the basic numerical methods used in many applications areas in computational science and engineering.

Topics Covered:

- Introduction: Floating point arithmetics, sources of errors
- Systems of Linear Equations: Gaussian elimination, pivoting, norms, condition numbers
- Linear Least Squares: Normal equations method, orthogonalization methods for full rank problems
- Solution of Nonlinear Equations: Bisection and secant methods, fixed point iteration, Newton's method
- Interpolation: Lagrange interpolation, Newton interpolation, Chebyshev polynomials, Hermite interpolation, Splines, Fast Fourier Transformation
- Numerical Differentiation and Integration: Trapezoidal rule, Simpson's rule, Newton-Cotes quadrature, Gaussian quadrature, adaptive quadrature, finite difference, Richardson extrapolation
- Numerical Solutions of Ordinary Differential Equations: initial value problems, systems of equations, Euler method, Runge-Kutta method
- Optimization (if the schedule allows): Existence of solutions, Optimization in one dimension, unconstrained and constrained optimizations, optimality conditions, Newton's method, Steepest descent, Conjugate gradient method

Course learning outcomes:

Students will learn the high level concepts and rationale behind the methods (in contrast to just numerical recipes) and learn how to choose and apply them to solve complex problems using computers. The course strives to be reasonably broad and domain neutral, while achieving depth in some selected key topics including linear system solvers, systems of nonlinear equations, interpolation and approximation of functions, numerical integration and differentiation, optimization, and numerical handling of ordinary differential equations.

Required course materials:

Scientific Computing: An Introductory Survey, Second Edition, Michael T. Heath, McGraw-Hill, 2002, ISBN 0-07-239910-4

Grading policy:

Class attendance: 6%

4 Homeworks: 44 %. Written problems and programming in MATLAB or Python, 11% each

Midterm Exam 1: 15 %, Feb. 19, Th., in class, open books/notes, no electronic devices allowed

Midterm Exam 2: 15 %, Apr. 2, Th., in class, open books/notes, no electronic devices allowed

Final Exam: 20 %, May 5, 2:40pm - 5:30pm, in the lecture room (Clough UG Learning Room 423), open books/notes, no electronic devices allowed

Attendance policy:

Class attendance counts for 6% of the total score for grading.

Academic honesty/integrity statement:

Students are expected to maintain the highest standards of academic integrity. All work submitted must be original and properly cited. Plagiarism, cheating, or any form of academic dishonesty will result in immediate consequences as outlined in the university's academic integrity policy.