

Course Outline for MATH 3651, Introduction to Numerical Analysis

MATH 3651 Introduction to Numerical Analysis (3 units)

Prerequisite: One of the following: MATH 242, MATH 244, [MATH 2341](#), or [MATH 2343](#); and one of the following: MATH 241, DATA/[MATH 1265](#), or [MATH 2263](#); and CSC 101 or [CSC 1001](#).

Introduction to basic numerical methods including finite precision arithmetic and error propagation, root-finding methods, interpolation, numerical differentiation and quadrature, direct and iterative methods for systems of linear equations, and numerical methods for eigenvalue problems and data fitting. 3 lectures. Formerly MATH 451.

Course Learning Objectives	
1	Compute errors in Taylor polynomial approximation and determine the effects of finite precision arithmetic and error propagation.
2	Analyze and implement root-finding methods to solve systems of nonlinear equations.
3	Approximate functions using polynomial interpolation and analyze the approximation error.
4	Approximate derivatives and integrals of functions using polynomial interpolation.
5	Analyze and implement direct and iterative methods for solving systems of linear equations
6	Analyze and implement numerical methods for computing eigenvalues of square matrices.
7	Approximate solutions to initial-value problems in ordinary differential equations using basic numerical methods and analyze the approximation error.

Expanded Course Content

Textbooks, materials, and/or other resources
Kendall Atkinson and Weimin Han, “Elementary Numerical Analysis (3rd edition), Publisher: John Wiley & Sons (2004).
Uri M. Ascher and Chen Greif, “A First Course in Numerical Methods”, Society of Industrial and Applied Mathematics (2011).

Week	Readings	Topics of Discussion
1	Atkinson and Han, Chapter 1	Error: Its sources, propagation, and analysis
2	Atkinson and Han, Chapter 2 (2.1-2.2)	Root-finding for nonlinear equations
3	Atkinson and Han, Chapter 2 (2.3, 2.8-2.9)	Root-finding for nonlinear equations
4	Atkinson and Han, Chapter 2 (2.10-2.11)	Root-finding for nonlinear equations
5	Atkinson and Han, Chapter 3 (3.1-3.2)	Interpolation Theory
6	Atkinson and Han, Chapter 3 (3.3-3.5)	Interpolation Theory
7	Atkinson and Han, Chapter 3 (3.6-3.8)	Interpolation Theory
8	Atkinson and Han, Chapter 4 (4.1-4.3)	Approximation of functions
9	Atkinson and Han, Chapter 4 (4.4-4.6)	Approximation of functions
10	Atkinson and Han, Chapter 5 (5.1-5.4, 5.7)	Numerical Integration
11	Atkinson and Han, Chapter 6 (6.2-6.5)	Numerical methods for ODEs
12	Atkinson and Han, Chapter 6 (6.8, 6.10, 6.11)	Numerical methods for ODEs
13	Atkinson and Han, Chapter 8 (8.1-8.3)	Numerical solution of systems of linear equations
14	Atkinson and Han, Chapter 8 (8.4-8.7)	Numerical solution of systems of linear equations
15	Atkinson and Han, Chapter 9 (9.1-9.5)	The matrix eigenvalue problem

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets or presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.