MATH 135B
Introduction to Numerical Analysis II

Course Description
Introduces basic numerical techniques for computing solutions of problems in science and engineering, as well as computational implementation of such techniques using MATLAB and Python. Topics include numerical integration, Runge-Kutta methods for initial value problems, matrix factorizations, eigenvalues, and eigenvectors.

Prerequisites
MATH 135A with a grade of C- or better; or equivalent; or consent of instructor.

Textbook
Numerical Mathematics and Computing (7th edition, 2013) by E. Ward Cheney and David R. Kincaid

Suggested Lecture Schedule

Week #	Textbook Section(s)	Topic(s)
1	5.1, 5.3	Numerical integration with trapezoidal method and Simpson's rule Lab – Implement the trapezoidal method and Simpson's rule using MATHLAB/Python (examples)
2	5.4	Gaussian quadrature rule Lab – Use Gaussian quadrature rule to approximate integrals (examples)
3		Introduce briefly derivation of a simple ordinary differential equation, analytical solutions to 1st order linear differential equations, examples in physics/engineering/biology Lab – Define an ODE initial value problem in MATLAB, visualize numerical solutions
4	7.1	Introduce initial value problems and the Taylor series method Lab – Implement basic Euler's method and solve population growth problems
5	7.3	Introduction to Runge-Kutta methods Lab – Use RK method to solve an epidemic problem
6	7.5	Introduce the Predictor-Corrector method and higher order ODEs Lab – Implementation and error analysis of the predictor-corrector method

7	11.1, 11.2	Introduce the boundary-value problems, shooting method, and finite difference method Lab – Implement shooting method to solve boundary value problems
8	8.1	Matrix decomposition, including LU, LDL^T, and Cholesky factorization Lab – Implement the LU decomposition for square and non-square matrices
9	8.2	Review of eigenvalues and eigenvectors, introduce the power method Lab – Compute the eigenvalue of give matrices using the direct and non-direct methods
10	8.4	Introduce the iterative methods of linear systems, including the Jacobi method, Gauss-Seidel method, and the successive overrelaxation method Lab – Implement the three iterative methods