

MATH 381 Numerical Analysis I

Catalog description: Solutions of nonlinear equations. Bisection, Newton`s, secant and fixed point iteration methods. Convergence, stability, error analysis and conditioning. Solving systems of linear equations: The LU and Cholesky factorization, pivoting, error analysis in Gaussian elimination. Matrix eigenvalue problem, power method, orthogonal factorizations and least squares problems.

Course Objectives: The objective of this course is to provide students mathematical foundations of numerical methods to analyze their stability, accuracy and mathematical complexity and demonstrate their performance in examples.

Course Coordinator: Baver Okutmuştur (Office: M242, Phone: 0-312- 210 2974)
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Course Website: <http://users.metu.edu.tr/baver/381.htm>

Textbooks:

- W. Cheney, D. Kincaid, Numerical mathematics and computations
- M. Tezer, C. Bozkaya, Numerical Analysis (2018)
- R. Burden and J. Faires, Numerical Analysis.

Exams and Grading: There will be **FIVE** exams (each of which is out of 14%) and a Final Exam (30 %). Midterm exams will be conducted through ODTUclass. The date and method for Final exam will be announced later.

NA Policy: If you miss three exams or more, you will receive a grade of NA for the course.

Make-up Policy: In order to be eligible to enter a make-up examination for a missed examination, a student should have a documented or verifiable, and officially acceptable excuse. A student cannot get make-up examinations for two missed exams. The make-up examination for all exams will be after the all exams and will include all topics.

Office Hours: Thursday 12:40-13:30

Lecture Hours: Tuesday 13:40-15:30, Thursday 12:40-13:30

Tentative Exam Dates:

- **1st Exam : Tuesday, 10. 11. 2020 at 13:40**
- **2nd Exam : Tuesday, 24. 11. 2020 at 13:40**
- **3rd Exam : Tuesday, 15. 12. 2020 at 13:40**
- **4th Exam : Tuesday, 29. 12. 2020 at 13:40**
- **5th Exam : Tuesday, 12. 01. 2021 at 13:40**

Tentative Course Schedule

Weeks	Topics
1-2 weeks	Mathematical Preliminaries and Error Analysis Review of basic concepts. Source of errors Propagation of errors Stability Order of convergence
2-3 weeks	Solutions of Nonlinear Equations--Root Finding Problems Bisection method. Newton-Raphson's method and its convergence Secant method and its convergence Fixed point iteration and its convergence Roots of polynomials
4-6 weeks	Solving Systems of Linear Equations Matrix Algebra LU-factorization Gaussian elimination method Pivoting Norms and error analysis Iterative methods for solving linear systems Overdetermined linear systems. Least-Square solutions
3-5 weeks	Eigenvalue problems. Eigenvalues and eigenvectors Localization of eigenvalues Iterative techniques to compute eigenvalues: Power method, inverse power method Orthogonal matrices. Orthogonal factorizations