Numerical Analysis I

1. SYLLABUS INFORMATION

1.1. Course title
Numerical Analysis I

1.2. University
Pázmány Péter Catholic University

1.3. Semester
1st year, 1st semester

2. COURSE DETAILS

2.1. Course nature
Elective

2.2. ECTS Credit allotment
5

2.3. Faculty data
Dr Mihály Kovács

3. COMPETENCES AND LEARNING OUTCOMES

3.1. Course objectives
The purpose of the course is to introduce selected modern topics in numerical analysis. Upon completion, students will have a basic understanding of various numerical methods, both in theory and practice. They will be able to write computer code for the algorithms studied and apply them to solve practical problems.

3.2. Course contents

- Solution of equations by iteration: simple, relaxation, Newton, and secant methods
- Polynomial interpolation: Lagrange and Hermite methods
- Applications of interpolation: numerical integration (simple and composite quadrature rules) and the theta method for solving initial value problems for ODEs
- Chebyshev polynomials
- Piecewise polynomial interpolation: splines (linear, natural cubic, Hermite cubic)
- Normed and inner product spaces
- Polynomial approximation in the infinity norm
- Polynomial approximation in the L2L_2L2 norm via Gram-Schmidt orthogonalization
- Condition number of matrices and sensitivity of linear systems to rounding errors
- QR factorization: Gram-Schmidt, modified Gram-Schmidt, and Householder triangularization
- Applications of QR factorization: solving linear systems, least squares problems, and finding eigenvalues of symmetric matrices
- Inverse iteration for finding eigenvectors

3.3. Course bibliography

DeVore, Ronald A.; Lorentz, George G.: Constructive approximation. Grundlehren der Mathema- tischen Wissenschaften [Fundamental Principles of Mathematical Sciences], vol. 303, Springer-Verlag, Berlin, 1993. x+449 pp. ISBN: 3-540-50627-6.

Suli, E.; Mayers, David F.: An introduction to numerical analysis. Cambridge University Press, Cambridge, 2003. x+433 pp. ISBN: 0-521-81026-4; 0-521-00794-1.

Trefethen, Lloyd N.; Bau, David, III.: Numerical linear algebra. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 1997. xii+361 pp. ISBN: 0-89871-361-7.

4. TEACHING AND LEARNING METHODOLOGIES AND STUDENT WORKLOAD

4.1. Contact hours

- Lectures: 2 hours/week
- Practice: 1 hour/week
- Lab: 1 hour/week

5. EVALUATION PROCEDURES AND WEIGHT OF COMPONENTS IN THE FINAL GRADE

Lab assignments, in-class tests, exam