

# Numerical Analysis I

## 1. SYLLABUS INFORMATION

### 1.1. Course title

Numerical Analysis I

### 1.2. University

Pázmány Péter Catholic University

### 1.3. Semester

1<sup>st</sup> year, 1st semester

## 2. COURSE DETAILS

### 2.1. Course nature

Compulsory

### 2.2. ECTS Credit allotment

4

### 2.3. Faculty data

Dr. Kovács Mihály

## 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 of the course the students will have a basic understanding of various numerical methods, both theory and practice. The students will be able to write a computer code for the algorithms they study and solve practical problems with them.

### 3.2. Course contents

Solution of equations by iteration (simple, relaxation, Newton, secant), polynomial interpolation (Lagrange, Hermite) and applications: numerical integration (simple and composite quadrature rules) and the theta method for solving initial value problems for ODE's, 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 2 norm via Gram-Schmidt orthogonalization, condition number of matrices and sensitivity of solutions linear systems to rounding errors, QR factorization (Gram-Schmidt, modified Gram-Schmidt, Householder triangularization) and its applications to solve linear systems, least squares problems and finding eigenvalues of a symmetric matrix, inverse iteration for finding eigenvectors

### 3.3. Course bibliography

DeVore, Ronald A.; Lorentz, George G.: Constructive approximation. Grundlehren der Mathematischen 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. EVALUATION

Lab assignments, in class tests, exam