M089	**Numerical Mathematics**	L	S	E	ECTS
		2	0	2	6

Course objectives. Students will become familiar with basic ideas and methods of numerical mathematics. We will thereby try to avoid theorems proving theorems, except in the case of constructive proofs that refer to generating ideas or creating methods themselves.

Course prerequisites. Differential Calculus, Integral Calculus, Linear Algebra I and II.

Syllabus.

1. Introduction. Error analysis. Significant digits. Floating point arithmetic. Error of the function. Inverse problem in error analysis.
2. Interpolation. Spline interpolation. Interpolation problem. Lagrange form of the interpolation polynomial. Newton form of the interpolation polynomial. Error estimation. Linear spline interpolation. Cubic spline interpolation.
3. Solving linear systems. Triangular systems. Gaussian elimination. LU - factorization - Cholesky–factorization. QR – factorization. Iterative methods. Singular value decomposition. Eigenvalue decomposition.
4. Solving nonlinear equations. Bisection method. Method of simple iteration. Newton method and modifications. Solving systems of nonlinear equations: Newton method, quasi-Newton methods.
5. Approximation of functions. Best polynomial. Best approximation. Orthogonal polynomial. Chebyshev's polynomial. Best approximation.
6. Linear and nonlinear least squares problem
7. Numerical integration. Trapezoidal rule. Newton-Cotes formula. Simpson rule.

EXPECTED LEARNING OUTCOMES.

No.	LEARNING OUTCOMES
1.	understand basic ideas and methods of numerical mathematics
2.	adopt ideas and methods for solving the interpolation problem and basic methods for solving the system of linear equations;
3.	adopt the main principles, ideas and methods for solving a nonlinear equation and ideas and methods for solving the system of nonlinear equations;
4.	adopt the idea of approximation of function, especially in case of a discrete (by least squares problem) and a continuous function (especially Fourier, Chebyshev and other orthogonal polynomials);
5.	adopt the basic principle and methods of numerical integration and numerical method for solving ordinary differential equations;
6.	be able to apply these principles and methods to solving simpler problems
7.	apply the acquired skills and knowledge to lifelong learning in this field

CONNECTING LEARNING OUTCOMES, ORGANIZATION OF TEACHING PROCESS AND ASSESSMENT OF STUDENT LEARNING OUTCOMES

TEACHING PROCESS ORGANIZATION	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	SCORE	
					min	max
In class participation	0.5	1-7	Attending lectures, discussions, teamwork and individual work on tasks	Participant lists, monitoring activities on class	0	4
Pieces of homework	1	1-7	Independent problem solving	Checking the correctness of solutions of the given pieces of homework	12	20
Midterms (preliminary exams)	1.5	1-7	Preparation for midterms	Checking the correctness of solution	19	38
Final exam	3	1-7	Recapitulation of the subject matter	Checking the correctness of answers on the final exam	19	38
UKUPNO	6				50	100

Teaching methods and student assessment. Exercises are partially auditory and partially laboratory with computer use. Lectures and exercises are obligatory. The exam is taken after the completion of lectures and exercises, and it consists of a written and oral part. Acceptable results achieved in mid-term exams taken during the semester replace the written part of the exam. Students may influence their grade by doing extra-credit assignments or writing a seminar paper.

Can the course be taught in English: Yes.

Basic literature:

1. R. Scitovski, Numerička matematika, Odjel za matematiku, Sveučilište u Osijeku, 2004.
2. R. Scitovski, Recenzirani nastavni materijali dostupni na web stranici predmeta.
3. N. Truhar; Numerička linearna algebra; Odjel za matematiku, Svučilišta u Osijeku, 2010.

Recommended literature:

1. J. E. Dennis,, Jr.R.B,Schnabel}, Numerical Methods for Unconstreined Optimization and Nonlinear Equations, SIAM, Philadelphia, 1996
2. D. Kincaid, W. Cheney, Numerical Analysis, Brooks/Cole Publishing Company, New York, 1996.
3. J. Stoer, R. Bulirsch, Introduction to Numerical Analysis, Springer Verlag, New York, 1993.
4. R. Plato, Concise Numerical Mathematics, American Mathematical Society, Providence, 2003.
5. W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling, Numerical Recipes, Cambridge, University Press, Cambridge, 1989.