M027	FIN,MR,IPM- obligatory - Semester 3	**Practicum in Mathematics**	L+P+S 2+0+2	ECTS 6

Course objectives. Students will be introduced to the methodology of scientific research with special stress placed on applied and numerical mathematics. After completion of this course, students should be able to solve the problem independently, conduct a literature search, write their own papers and know how to present them in an interesting way.

Course prerequisites: Undergraduate study programme in mathematics.

Syllabus.
Several topics are selected every year, that are considered from the point of view of applications to other sciences. Topics are selected among the ones given below or new topics are defined.
1. Data generation and presentation. Data analysis. Representative of the data. Lp ($p \geq 1$) distance from a point to a line and a curve in plane and space. Distance between two curves in plane and in space. Data clustering. Distance-like functions. Indexes.
2. Interpolation and approximation. Interpolating spline. Linear and cubic least squares spline. The best Lp ($p \geq 1$) approximation. The best least squares and total least squares line. Fast Fourier transformations.
3. Systems of linear and nonlinear equations. Solving a special system of linear equations. Iterative methods. Eigenvalue problem. Methods for solving a system of nonlinear equations.
4. Optimization. Gauss-Newton method. One-dimensional minimization. Minimization in several dimensions. Global optimization.
5. Numerical solution of ordinary differential equations. Numerical solution of partially differential equations.

Expected learning outcomes.
After completion of this course, students are expected to:
- master the methodology of scientific research with special stress placed on applied and numerical mathematics;
- be able to solve specific problems independently, which also includes independent search of relevant literature;
- get necessary insight into several new areas of mathematical research (e.g. Data Mining);
- accept cooperation with other professions and learn how to adjust the acquired mathematical knowledge in various applications;
- learn how to present their own work in an interesting way.

Teaching methods and student assessment. Lectures are illustrated by ready-made software and graphics by means of Mathematica or Matlab. Special cases, assignments and student seminar papers are analyzed in seminars. Lectures and seminars are obligatory. The exam is taken after completion of lectures and exercises, and it consists of a written and an 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. A seminar paper of good quality leads to a higher grade, it is published on the Department's website, and high-quality seminar papers are encouraged to be published in professional journals and scientific and professional conference proceedings.

Can the course be taught in English: Yes.

Basic literature:

1. R. Scitovski, K. Sabo, Matematički praktikum, reviewed course materials available on the course website, Odjel za matematiku, 2008-2011.
2. K. Sabo, R. Scitovski, I. Vazler, Grupiranje podataka: klasteri, Osječki matematički list 10(2010), 149-178.
3. R. Scitovski, Numerička matematika, Odjel za matematiku, Sveučilište u Osijeku, Osijek, 2004.
4. Journals: The College Mathematical Journal, Mathematics Magazine, The Mathematical Inteligencer

Recommended literature:

1. J. E. Dennis, Jr. R. B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM, Philadelphia, 1996.
2. D. Kincaid, W. Cheney, Numerical Analysis, Brooks/Cole Publishing Company, New York, 1996.
3. R. Plato, Concise Numerical Mathematics, American Mathematical Society, Providence, 2003.
4. J. Kogan, Introduction to Clustering Large and High-Dimensional Data, Cambridge University Press, 2007.
5. A. Neumaier, Complete search in continuous global optimization and constraint satisfaction, Acta Numerica (2006), 271-369.
6. Z. Drezner, Facility Location: A Survey of Aplications and Methods, Springer-Verlag, Berlin, 2004.