Course Unit Descriptor

Study Programme: Mathematics (MA), Applied Mathematics (MB), Master in Mathematics Teaching (MP)

Course Unit Title: Numerical Solving of Partial Differential Equations

Course Unit Code: MB43

Name of Lecturer(s): Helena Zarin

Type and Level of Studies: Master

Course Status (compulsory/elective): elective

Semester (winter/summer): summer

Language of instruction: Serbian

Mode of course unit delivery (face-to-face/distance learning): face-to-face

Number of ECTS Allocated: 5

Prerequisites: Partial Differential Equations

Course Aims:

Introducing students to specific procedures for the numerical solution of some classes of partial differential equations. The aim of practical exercises is mastering theoretical contents within independent work on the computer.

Learning Outcomes:

Student should be qualified for the theoretical analysis and practical application of some numerical methods for solving elliptic and parabolic partial differential equations.

Syllabus:

Theory

Elliptic partial differential equations. Maximum principle. Finite difference methods. Stability and convergence. Weak solution of Dirichlet and Neumann problem. Finite element methods. A priori and aposteriori error bounds. Finite volume methods.
Parabolic partial differential equations. Maximum principle. Explicit and implicit methods. θ-methods. Semidiscretization. Spectral methods. Collocation methods.

Practice

Elliptic PDEs. Variational formulation. Finite difference method for Poisson PDE. Triangulation. Polynomial approximations in Sobolev spaces. Galerkin methods.
Parabolic PDEs. Heat equation. Euler and Crank-Nicolson scheme. Error analysis. Finite element approximations.

Required Reading:

1. S. Larsson, V. Thomee, *Partial Differential Equations with Numerical Methods*, Springer, 2005.
2. P. Knabner, L. Angermann, *Numerical Methods for Elliptic and Parabolic Partial Differential Equations*, Springer, 2003.
3. A. Quarteroni, A. Valli, *Numerical Approximation of Partial Differential Equations*, Springer, 1997.
4. S.C. Brenner, L.R. Scott, *The Mathematical Theory of Finite Element Methods*, Springer, 2002.

Weekly Contact Hours: 4	**Lectures:** 3	**Practical work:** 1

Teaching Methods:

Lectures are presented using classical teaching methods and supported by beamer presentations. Exercises are used to practice the theoretical part within the independent work on a computer using the adequate software packages. The ability of application of theoretical knowledge is verified through presentation of the seminar paper and independent solving of test problems. At the final oral examination, the student should demonstrate comprehensive understanding of the presented theoretical material.

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points

Term paper	25		
Test	25	oral exam	50