M133	**Partial differential equations**	L	P	S	ECTS
		4	2	0	8

Course objectives. To familiarize students with problems that can be modelled with partial differential equations, basic properties and classical methods for solving them, and with modern theory of partial differential equations.

Prerequisites. Knowledge of basic results of the real analysis and ordinary differential equations.

Course content.

1. Introduction: examples of partial differential equations and physical interpretation, classification, notion of well-possed problem and main questions in studying partial differential equations, elementary methods for finding solutions.
2. First-order linear equation: methods of characteristics.
3. Second-order linear equations: Laplace and Poisson equation, heat equation, wave equation. Fundamental solutions, mean-value formulae, maximum principle, representation formulae for solution, energy functionals, propagation speed for evolution equations.
4. Transformations methods. Fourier and Laplace transformation.
5. Nonlinear equations: shock waves and loss of regularity of the solution, notion of weak solution.
6. Energy methods for second-order elliptic equation.
7. Semi-group theory and its application on evolution equations.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Identify the real-world problems which can be modelled with partial differential equations
2.	Understand and explain fundamental notions, such as solution of an equation, Cauchy problem, initial-boundary-value problem, sensitivity to initial conditions
3.	Classificate partial differential equations based on different criteria.
4.	Use elementary methods for solving equations.
5.	Explain main properties, similarities and differences between four most important linear equations: transport equation, Poisson equation, heat equation and wave equation.
6.	Recognize main difficulties appearing in nonlinear equations, such as shock waves and loss of regularity of the solution.
7.	Analyse and prove main properties of elliptic and evolution equations, by using modern tools of functional analysis.
8.	Formulate conjectures related to the subject, and prove or deny them.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures	1	1-8	Lecture attendance, discussion, team work and independent work on given tasks	Attendance lists, tracking activities	0	4

Written exam (Mid-terms)	3	1-8	Preparing for written exam	Evaluation	25	48
Final exam	4	1-8	Revision	Oral exam	25	48
TOTAL	8				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. The exam consists of a written and an oral part. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam.

Can the course be taught in English: Yes

Basic literature:

1. I. Aganović, K. Veselić, Linearne diferencijalne jednadžbe, Element, Zagreb, 1997.
2. L. C. Evans, Partial differential equations, AMS, 1998.

Recommended literature:

1. F. John, Partial differential equations, Springer Verlag, 1982.
2. M. Renardy, R. C. Rogers, An introduction to partial differential equations, Springer Verlag, 1993.