

M035	Obligatory - Semester 5	<b>Ordinary Differential Equations</b>	L+P+S 2+2+0	ECTS 5
------	-------------------------	--	----------------	-----------

**Course objectives.** Introduce students to the concept and geometric meaning of ordinary differential equations as well as general theorems of existence and uniqueness of solutions. Demonstrate basic types and methods for finding a solution with particular emphasis on the theory of linear equations.

**Course prerequisites.** Differential Calculus, Integral Calculus, Multivariable Calculus, Applications of Calculus I.

### Syllabus.

1. Introduction. Sources of ordinary differential equations (Problems of growth, radioactive decay, cooling problems, electrical networks, orthogonal trajectories, the predator / prey model, system of several masses and springs). Notion of solutions: general and particular. Cauchy problem. The slope field and geometric meaning. Problem of sensibility on change of initial conditions.
2. Ordinary differential equations of the first order. Existence and uniqueness theorems: Picard, Cauchy and Peano. Some types of ordinary differential equations of the first order (with separable variables, homogeneous, linear, Bernoulli, exact, Lagrange, Clairaut, Riccati). Applications.
3. Ordinary differential equations of higher order, which allow reduction of order.
4. Systems of ordinary differential equations. General results for linear equations and systems. Equivalence theorem. Fundamental system of solutions, matrix and determinant of Wronski.
5. Linear differential equations of second order. Lagrange's method of variation of constants. Linear differential equations of second order with constant coefficients. Method of undetermined coefficients. Linear differential equations of higher order. Laplace transform. Variational principle. Applications.
6. Systems of linear ordinary differential equations. Lagrange's method of variation of constants. Systems of linear differential equations with constant coefficients. Applications.
7. Partial differential equation. Concept and examples from applications.

### Expected learning outcomes.

After completing the course, students are expected to:

- identify some real world problems that can be modeled by differential equations;
- identify and explain fundamental concepts, such as a solution of equation, Cauchy problem, slope field and sensitivity to initial conditions;
- classify differential equations by various criteria;
- express in their own words conditions that ensure the existence (and uniqueness) of a solution of the Cauchy problem;
- solve different types of equations of the first order as well as higher order equations that allow reduction of order;
- recognize characteristic properties of linear equations and systems, which distinguish them from non-linear;
- solve linear equations and systems;
- recognize basic examples of partial differential equations.

**Teaching methods and student assessment.** Lectures and exercises are mandatory. The exam consists of a written and an oral part and it is taken after the completion of lectures and exercises. Acceptable scores achieved in mid-term exams taken throughout the semester replace the written part of examination.

**Can the course be taught in English:** Yes.

### Basic literature:

1. W. E. Boyce, R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 7th edition, John Wiley & Sons, 2000.

**Recommended literature:**

1. M. Alić, Obične diferencijalne jednačbe, PMF - Matematički odjel, Zagreb, 2001.
2. I. Ivanšić, Fourierovi redovi. Diferencijalne jednačbe, Odjel za matematiku, Osijek, 2000.
3. G. F. Simmons, J. S. Robertson, Differential Equations with Applications and Historical Notes, 2nd Ed., McGraw-Hill, Inc., New York, 1991.
4. M. Braun, Differential equations and their applications, Springer-Verlag, New York, 1993.
5. J. D. Logan, A first course in differential equations, Springer Science+Business Media, Inc., 2006.
6. B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986.