

## Continuous Mathematical Models

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
3	108	Exam

The aim of the course is to gain theoretical knowledge about the types and structure of continuous mathematical models, about the methods of their analytical and numerical solution, as well as about the use of models for solving practical problems, taking into account the need to choose a suitable mathematical apparatus for creating models, developing, analyzing and interpreting the results of modeling.

### Course structure:

#### 1. Introduction to continuous mathematical models

1.1. Definition and tasks of modeling. The history of the development of the mathematical apparatus for creating models. Continuous mathematical models, their advantages and disadvantages

#### 2. Analytical study of continuous mathematical models

2.1. Formalization of continuous models using ordinary differential equations (ODE). Modeling with first-order ODEs. Investigation of models by finding solutions to ODEs in explicit form (cases of separable equations, homogeneous equations, equations in total differentials, linear equations of the first order)

2.2. Modeling with higher-order ODEs. Investigation of models by finding solutions to the ODE in an explicit form (cases of equations admitting a reduction in order, linear equations of the second or more degree)

2.3. Modeling using ODE systems. Models based on boundary value problems. Models based on partial differential equations

#### 3. Numerical study of continuous mathematical models

3.1. Reasons for the transition from analytical to numerical methods. Types of numerical methods. Features of the application of numerical methods to study continuous mathematical models

3.2. Examples of studying models using numerical methods (methods of Euler, Euler-Cauchy, Runge-Kutta, Adams). Investigation of continuous mathematical models using computers

#### 4. Stability and equilibrium positions of dynamic systems

4.1. Application of stability theory to the study of continuous models

4.2. Equilibrium positions of a dynamic system. Phase portrait

### 4.3. Investigating Continuous Models Using Equilibrium Analysis

## 5. Basics of designing and setting models for data

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5.1. Stages of modeling. Features of using continuous models for solving scientific and practical problems

5.2. Rules for constructing a continuous mathematical model. Features of setting continuous models for data

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