Study programme(s): Mathematics (M), Integrated Mathematics Studies (M5), Applied Mathematics (MAP)

Course title: MODELING OF DYNAMICAL SYSTEMS (M143)

Lecturer(s): Vladimir R. Kostić

Course status: elective (M, M5), compulsory on module: Data Analytics and Statistics (MAP)

ECTS points: 5

Requirements: Analysis 1 (on M), Differential and Integral Calculus (on MAP), Linear Algebra, Programming 1

Learning Objectives

Introducing students to the mathematical foundations of dynamical systems, their modeling using object-oriented modeling language Modelica, and training to perform computer simulations in order to acquire skills for multidisciplinary professional and scientific cooperation in the field of applications in technology, industry, and economy.

Learning Outcomes

Students will be trained to independently model complex systems on a computer, they will gain the ability to define systems of algebraic and differential equations that describe real dynamical processes. Through computer aided simulations students will gain insights that facilitate a faster learning and better education quality in the field of applied mathematics.

Syllabus

Theoretical instructions

Introduction to the mathematical foundations of dynamical systems. Introduction to differential equations and systems of algebraic and differential equations (ADE). Modeling of the fundamental laws of nature by systems of ADEs. Simulating the operation of dynamical systems and understanding the physical and technical significance of the corresponding systems of ADEs.

Practical classes

Basics of the object-oriented modeling language Modelica. Introduction to the basic components of dynamical systems in the OpenModelica environment and the equations that model them. Modeling of simple and more complex dynamical systems and their simulation – discrete and continuous models. Analysis of the simulation results and understanding of the physical and technical properties of the modeled system.

Literature

1. D. Hinrichsen, A. J. Pritchard, **Mathematical Systems Theory I – Modeling, State Space Analysis, Stability and Robustness**, Texts in Applied Mathematics, Springer (2005)
2. P. Fritzson, **Principles of Object-Oriented Modeling and Simulation with Modelica 2.1**, Wiley (2003)
3. P. Fritzson, **Introduction to Modeling and Simulation of Technical and Physical Systems**, Wiley (2011)

Number of active classes	**Lectures: 2**	**Exercises: 2**

Teaching methods

Lectures with active student participation. Independent work on a computer. Testing of the acquired skills on specific examples from practice.

Grading (maximum number of points 100)

Pre-exam obligations	Points	**Final exam**	Points
colloquia	**40**	oral exam	**40**
seminars	**20**		