Study programme(s): Mathematics (M3), Mathematics (M4),

Level: bachelor

Course title: Modelling of Dynamical Systems (M3-11)

Lecturer: Vladimir R. Kostić

Status: elective

ECTS: 5

Requirements: Analysis 1

Learning objectives

To introduce the students to the mathematical foundations of dynamical systems, their modelling using object-oriented modelling 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, economy and development projects of modern society.

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 the real dynamical processes, and to gain insights through simulations that will enable them for faster learning and higher quality of education in the field of applied mathematics.

Syllabus

Theoretical instruction

Introduction to the mathematical foundation of dynamical systems. Introduction to differential equations and systems of algebraic and differential equations (ADE). Modelling of the fundamental laws of nature by systems of ADE. Simulation of dynamical systems and understanding of the physical and technical significance of the corresponding systems of ADE.
A brief introduction to the mathematical formulation of the solutions of systems of ADE.
A brief introduction to the development of algorithms to solve and optimize the systems of ADE.

Practical instruction

Fundamentals of object-oriented modelling language Modelica. Introduction to the basic components of dynamical systems in OpenModelica environment and equations to model them.
Modelling of simple dynamical systems and their simulations - discrete and continuous models.
Modelling of more complex dynamical systems and their simulations - discrete and continuous models. Analysis of the simulation results and understanding of the physical and technical properties of the modelled 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)

Weekly teaching load				Other: 0
Lectures: 2	Exercises: 2	Other forms of teaching: 0	Student research: 0	

Teaching methodology

Lectures with active participation of students. Independent work on computer exercises. Testing of the acquired skills in specific examples from practice.

Grading (maximum number of points 100)

Pre-exam obligations	**points**	**Final exam**	**points**
Colloquia	50	written exam	50