Study programme(s): Computer Science

Level: master

Course title: Differential Equations

Lecturer: Dušanka Perišić

Status: elective

ECTS: 6

Requirements:

Learning objectives

The aim of the course is to help students gain expertise in understanding, constructing, solving, and interpreting ordinary differential equations (ODE's), with ephasise on understanding the interplay between analitic, graphic, and numeric representations of differential equations and the contextual situations that particular equations are intended to model.

Learning outcomes

Students should gain personal mastery over the following skills:

1. Model a simple system to obtain a first order ODE.
2. Visualize solutions using direction fields and isoclines, and approximate them using Euler's method.
3. Solve a first order linear ODE by the method of integrating factors or variation of parameter.
4. Solve a constant coefficient second order linear initial value problem with driving term exponential times polynomial. If the input signal is sinusoidal, compute amplitude gain and phase shift..
5. Utilize Delta functions to model abrupt phenomena, compute the unit impulse response, and express the system response to a general signal by means of the convolution integral.
6. Solve constant coefficient linear initial value problems using the Laplace transform together with tables of standard values.
7. Solve first order linear systems. Relate first order systems with higher-order ODEs.
8. Determine the qualitative behavior of an autonomous nonlinear two-dimensional system by means of an analysis of behavior near critical points.

Syllabus

Topics include:

- Solution of First-order ODE's by Analytical, Graphical and Numerical Methods;
- Linear ODE's, Especially Second Order with Constant Coefficients;
- Sinusoidal and Exponential Signals: Oscillations, Damping, Resonance;
- Laplace Transform Methods;
- Matrix and First-order Linear Systems: Eigenvalues and Eigenvectors; and
- Non-linear Autonomous Systems: Critical Point Analysis and Phase Plane Diagrams.
- Difference equations vs. differential equations
- Elements of modeling real phenomena

Literature

1. Edwards, C., and D. Penney. *Elementary Differential Equations with Boundary Value Problems*. 6th ed. Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 9780136006138.
2. MITOPENCORSEWARE https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/#

<table>
<tr><td colspan="4">Weekly teaching load</td><td rowspan="2">Other:
0</td></tr>
<tr><td>Lectures:
2</td><td>Exercises:</td><td>Practical Exercises:
2</td><td>Student research:
0</td></tr>
<tr><td colspan="5">Teaching methodology
Lecture sessions and exercise sessions using computers.This course employs a series of Java™ applets, which are avaiable at the MIT web site https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/index.htm# They are used in lecture to ilustrate main concepts, and each homework assigment contains a problem based around one or another of them.</td></tr>
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Grading method (maximal number of points 100)			
Pre-exam obligations	**points**	**Final exam**	**points**
Two homework assignments	**15+15**	*Oral exam*	*40*
Two hour written exam	**30**		