



## Course: Control Engineering

<b>Study program:</b>	Academic level 1st cycle study program "Electrical Engineering"	<b>Študijski program:</b>	Univerzitetni dodiplomski študijski program 1. stopnje Elektrotehnika
<b>Code:</b>	<b>64156</b>	<b>Šifra:</b>	<b>64156</b>
<b>Title:</b>	<b>Control Engineering</b>	<b>Naslov:</b>	<b>Regulacijska tehnika</b>
<b>Year:</b>	<b>3rd</b>	<b>Letnik:</b>	<b>3.</b>
<b>Semester:</b>	<b>Winter</b>	<b>Semester:</b>	<b>zimski</b>
<b>ECTS credits:</b>	<b>6</b>	<b>Kreditne točke ECTS:</b>	<b>6</b>
<b>Lectures (hours):</b>	<b>60</b>	<b>Predavanja (ur):</b>	<b>60</b>
<b>Tutorial (hours):</b>	<b>0</b>	<b>Avditorne vaje (ur):</b>	<b>0</b>
<b>Lab. work (hours):</b>	<b>30</b>	<b>Laboratorijske vaje (ur):</b>	<b>30</b>

**Title: Control Engineering**

**Lecturer:** Prof. Dr. David Nedeljković

### **Aim of the course:**

Student will master fundamental topics in the field of control engineering, with emphasis on linear systems. He will meet a variety of methods to design control systems and learn how to use these methods with state-of-the-art software tools.

Student will become aware of the modeling inadequacies and will develop a critical approach to design of control systems, especially in the field of power electronics and electrical drives.

### **Required (pre)knowledge:**

Mathematics I-IV, Physics I-II, Electrical Engineering Fundamentals I-II, Measurements, Electrical Machines.

### **Contents:**

Linear systems and their descriptions: differential equations, state space, Laplace transform and transfer function, frequency response (Bode, Nyquist, Nichols plots), step response.

Block diagrams, open-loop, closed-loop systems and corresponding transfer functions.

Linearization and normalization.

Stability, steady state error, dynamic error.

Features of elements of control systems in power electronics and electrical drives.

PID controllers, their realization with operational amplifiers and microcontrollers.

Optimization of controllers' parameters.

Cascade control systems, process control systems.

Features of digital control, Z-transform.

Influence of nonlinearities, limit cycles, integrator wind-up.

Basics of simulations and use of appropriate tools in control system design.

Examples of control systems in power electronics and electrical drives.

### **Selected references:**

Gene F. Franklin, J. David Powell, Abbas Emami-Naeini: Feedback Control of Dynamic Systems, Addison-Wesley, 1994.

Dogan Ibrahim: Microcontroller Based Applied Digital Control: J. Wiley & Sons, 2006.

Werner Leonhard: Control of Electrical Drives, Springer; 2001.