

Syllabus

Course Description

Course Title	Modern Control
Course Code	42412
Course Title Additional	
Scientific-Disciplinary Sector	IINF-04/A
Language	English
Degree Course	Bachelor in Electronics and Cyber-Physical Systems Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Karl Dietrich von Ellenrieder, Karl.vonEllenrieder@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/37038
Teaching Assistant	
Semester	First semester
Course Year/s	3
CP	9
Teaching Hours	36
Lab Hours	54
Individual Study Hours	135
Planned Office Hours	27
Contents Summary	<ol style="list-style-type: none"> 1. Modelling and systems analysis in state space (dynamic system modelling in time domain and state-space representation). 2. Dynamic system response derived from state-space representation and steady-state error. 3. Stability in state space. 4. Control design in state space (Pole placement design techniques; controllability, observability, full-state observers). 5. Optimal control of dynamic systems (Problems with fixed and variable end-points as well as with equality and inequality constraints; maximum principle and Hamilton-Jacobi-Bellmann equation; linear quadratic regulator).

	6. Understanding of observers in control systems. 7. Understanding of optimal state observers and Kalman filters. 8. Computer-aided analysis and design using Matlab/Simulink. 9. Implementation of controllers and experimental evaluation on real-hardware setups.
Course Topics	1. Modelling and systems analysis in state space (dynamic system modelling in time domain and state-space representation). 2. Dynamic system response derived from state-space representation and steady-state error. 3. Stability in state space. 4. Control design in state space (Pole placement design techniques; controllability, observability, full-state observers). 5. Optimal control of dynamic systems (Problems with fixed and variable end-points as well as with equality and inequality constraints; maximum principle and Hamilton-Jacobi-Bellmann equation; linear quadratic regulator). 6. Understanding of observers in control systems. 7. Understanding of optimal state observers and Kalman filters. 8. Computer-aided analysis and design using Matlab/Simulink. 9. Implementation of controllers and experimental evaluation on real-hardware setups.
Keywords	automatic control, state space, control design, linear observers, linear quadratic regulators
Recommended Prerequisites	Lectures and exercises of Mathematical Analysis I and II; Linear Algebra; Physics I; Physics II; and Fundamentals of Systems and Control
Propaedeutic Courses	
Teaching Format	Lessons are divided into i) theoretical classroom lessons, ii) classroom exercises, and iii) lab exercises.
Mandatory Attendance	Attendance at lectures, exercises, and labs is strongly recommended
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding Knowledge and understanding in the field of: <ol style="list-style-type: none"> 1. State-space modelling and control 2. Optimal control 3. Observers Applying knowledge and understanding

	<p>4. Ability to apply knowledge for solving given problems, including solving them with numerical data using software packages like Matlab/Simulink and their implementation and evaluation on real hardware setups.</p> <p>Making judgements</p> <p>5. Ability to judge plausibility of results.</p> <p>Communication skills</p> <p>6. In-class exercises will require you justify your solutions/conclusions concisely (in clear and simple language).</p> <p>Ability to learn</p> <p>7. Learning skills to independently study and apply methods of modern control for specific applications beyond topics covered in this lecture.</p>
Specific Educational Objectives and Learning Outcomes (additional info.)	The student should understand the basic principles of methods of modern control with focus on state-space control and optimal control and be able to apply them in exercises, including in Matlab and Simulink, as well as in laboratory experiments on real hardware.
Assessment	<p>Written Final Exam (Theory) 60% Length /duration: 3 hours</p> <p>Laboratory Final Exam (Measurements + report) 40% Length /duration: 1 hour</p> <p>ILOs assessed: 1-7</p>
Evaluation Criteria	<p>Written Final Exam: Completeness and correctness of answers; level of understanding.</p> <p>Laboratory Final Exam: Completeness and correctness of report; level of observation of physical processes.</p> <p>Students must receive an overall grade of greater than 60/100 points to pass the course.</p>
Required Readings	Lecture notes provided
Supplementary Readings	Additional books and articles may be recommended by the instructor during the course.
Further Information	
Sustainable Development	Quality education

Goals (SDGs)	
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