Syllabus

Course Description

Course Title	Systems and Control
Course Code	42188
Course Title Additional	
Scientific-Disciplinary Sector	IINF-04/A
Language	Italian
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Marco Frego, Marco.Frego@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/44497
Teaching Assistant	
Semester	Second semester
Course Year/s	2, 3
CP	12
Teaching Hours	36
Lab Hours	24
Individual Study Hours	0
Planned Office Hours	
Contents Summary	The Systems and Control Theory course is a specialization subject within the Bachelor's degree program in Industrial and Mechanical Engineering and serves to acquire professional skills and methodological knowledge of the systems and control theory of linear systems in the frequency domain. Module 1: 1. Dynamic system modelling in frequency domain 2. Dynamic system response 3. Stability of linear control systems 4. Root-locus analysis and design methods

	5. Frequency-response analysis and design methods 6. Digital control systems (time permitting). Module 2: 1. Introduction to Matlab 2. Introduction to Simulink 3. Simulation of dynamic systems in the frequency domain with the Control System Toolbox 4. Computer-aided analysis and design in Matlab/Simulink 5. Real experiments of control in the lab
Course Topics	The first module includes 36 hours of frontal lectures and 24 hours of classroom exercises in systems and control theory of linear systems in the frequency domain. The second module introduces students to the simulation software Matlab/Simulink in a further 60 hours and includes a series of control engineering experiments in the laboratory in which both mechatronic and fluid dynamic systems are first simulated and then controlled in real experiments.
Keywords	controls, systems, automatica, Matlab
Recommended Prerequisites	Mathematical Analysis I and II; Linear Algebra; Physics I and II.
Propaedeutic Courses	
Teaching Format	The lessons are divided into theoretical classroom lessons and in-class exercises.
Mandatory Attendance	Recommended.
Specific Educational Objectives and Learning Outcomes	ILOs Module 2: Knowledge and understanding: Knowledge and understanding in the field of: 1. Theory of modelling and control of linear systems in frequency domain Applying knowledge and understanding: 2. Ability to apply knowledge for solving given problems, including solving them with numerical data. Making judgements: 3. Ability to judge plausibility of results. Communication skills:

	4. Maturing of technical-scientific terminology. Ability to learn: Learning skills to independently study and apply methods of systems and control for specific applications beyond topics covered in this lecture.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The exam covers topics of MODULE 1 and MODULE 2 ab and has the following form: • MODULE 1 (50% of the final exam): Written: 180 minutes; ILOs assessed: 1-5. • MODULE 2 (50% of the final exam): Written: 120 minutes; ILOs assessed: 1-5.
Evaluation Criteria	The final mark is computed as the average of the two module marks. The exam is considered passed when both marks are valid, i.e., in the range 18-30. Otherwise, the individual valid marks (if any) are kept for all 3 regular exam sessions, until also all other parts are completed with a valid mark. After the 3 regular exam sessions, all marks become invalid. • MODULE 1: The written exam consists of several mathematical tasks to be solved, which are distributed among the various topics covered. Judged will be: o the correctness of the approach and the mathematical steps of the solution, the calculation of numerical results; o the correctness of the provided answers and arguments presented and the terminology used. • MODULE 2: The exam comprises tasks that are to be solved with Matlab and Simulink and requires knowledge of the handling of the simulation software as well as knowledge of methods of control theory of linear systems in the frequency domain from Module 1.

	The formal and methodological correctness of the answers will be evaluated as well as the calculations and the graphical representation of the results.
Required Readings	Course slides and Control Systems Engineering – Global Edition, Norman S. Nise, Wiley, 2017 (based on 7th edition from 2015).
Supplementary Readings	Feedback Control of Dynamic Systems – Global Edition, Gene F. Franklin, J. D. Powell, A. Emami-Naeini, Pearson, Global Edition, 2015 (based on 7th edition from 2015) Modern Control Engineering – International edition 5/E, Katsuhiko Ogata, Pearson, 2010. Automatic Control Systems, Farid Golnaraghi, Benjamin C. Kuo, 10th Edition, Mc Graw Hill Education, 2017. Modern Control Systems, Global Edition 13/E, Dorf & Bishop, Pearson, 2018. A MATLAB Primer for Technical Programming in Materials Science and Engineering - Leonid Burstein -Woodhead Publishing Elsevier – 2020 MATLAB A Practical Introduction to Programming and Problem Solving - Stormy Attaway - Second Edition - Butterworth-Heinemann Elsevier – 2012 MATLAB, Simulink, Stateflow - Angermann, Rau, Beuschel, Wohlfarth -De Gruyter (in German) 9th ed. 2017
Further Information	Software used: Matlab/Simulink.
Sustainable Development Goals (SDGs)	Quality education

Course Module

Course Constituent Title	Systems and Control

Course Code	42188A
Scientific-Disciplinary Sector	IINF-04/A
Language	Italian
Lecturers	Prof. Marco Frego, Marco.Frego@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/44497
Teaching Assistant	
Semester	Second semester
CP	6
Responsible Lecturer	
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	
Contents Summary	1. Dynamic system modelling in frequency domain 2. Dynamic system response 3. Stability of linear control systems 4. Root-locus analysis and design methods 5. Frequency-response analysis and design methods 6. Digital control systems (time permitting).
Course Topics	The first module includes 36 hours of frontal lectures and 24 hours of classroom exercises in systems and control theory of linear systems in the frequency domain.
Teaching Format	The lessons are divided into theoretical classroom lessons and in-class exercises.
Required Readings	Control Systems Engineering – Global Edition, Norman S. Nise, Wiley, 2017 (based on 7th edition from 2015) Course Slides
Supplementary Readings	Feedback Control of Dynamic Systems – Global Edition, Gene F. Franklin, J. D. Powell, A. Emami-Naeini, Pearson, Global Edition, 2015 (based on 7th edition from 2015)

	Modern Control Engineering – International edition 5/E, Katsuhiko Ogata, Pearson, 2010. Automatic Control Systems, Farid Golnaraghi, Benjamin C. Kuo, 10th Edition, Mc Graw Hill Education, 2017. Modern Control Systems, Global Edition 13/E, Dorf & Bishop, Pearson, 2018. A MATLAB Primer for Technical Programming in Materials Science and Engineering - Leonid Burstein -Woodhead Publishing Elsevier – 2020 MATLAB A Practical Introduction to Programming and Problem Solving - Stormy Attaway - Second Edition - Butterworth-Heinemann Elsevier – 2012 MATLAB, Simulink, Stateflow - Angermann, Rau, Beuschel, Wohlfarth -De Gruyter (in German) 9th ed. 2017

Course Module

Course Constituent Title	Systems and Control Laboratory
Course Code	42188B
Scientific-Disciplinary Sector	IINF-04/A
Language	German
Lecturers	Prof. Marco Frego, Marco.Frego@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/44497
Teaching Assistant	
Semester	Not defined
CP	6
Responsible Lecturer	
Teaching Hours	0

Lab Hours	60
Individual Study Hours	0
Planned Office Hours	36
Contents Summary	1. Introduction to Matlab 2. Introduction to Simulink 3. Simulation of dynamic systems in the frequency domain with the Control System Toolbox 4. Computer-aided analysis and design in Matlab/Simulink 5. Real experiments of control in the lab
Course Topics	The second module introduces students to the simulation software Matlab/Simulink in a further 60 hours and includes a series of control engineering experiments in the laboratory in which both mechatronic and fluid dynamic systems are first simulated and then controlled in real experiments.
Teaching Format	The lessons are divided between an introduction to the simulation software Matlab/Simulink in the classroom and experiments in the laboratory.
Required Readings	Course slides and Control Systems Engineering – Global Edition, Norman S. Nise, Wiley, 2017 (based on 7th edition from 2015).
Supplementary Readings	Feedback Control of Dynamic Systems – Global Edition, Gene F. Franklin, J. D. Powell, A. Emami-Naeini, Pearson, Global Edition, 2015 (based on 7th edition from 2015) Modern Control Engineering – International edition 5/E, Katsuhiko Ogata, Pearson, 2010. Automatic Control Systems, Farid Golnaraghi, Benjamin C. Kuo, 10th Edition, Mc Graw Hill Education, 2017. Modern Control Systems, Global Edition 13/E, Dorf & Bishop, Pearson, 2018. A MATLAB Primer for Technical Programming in Materials Science and Engineering - Leonid Burstein -Woodhead Publishing Elsevier

	– 2020 MATLAB A Practical Introduction to Programming and Problem Solving - Stormy Attaway - Second Edition - Butterworth-Heinemann Elsevier – 2012 MATLAB, Simulink, Stateflow - Angermann, Rau, Beuschel, Wohlfarth -De Gruyter (in German) 9th ed. 2017