Politecnico di Bari

Courses offered by the Doctoral School of Politecnico di Bari

DAUSY

Course title	Distributed/Decentralized Control and Optimization of Large-Scale Systems
Lecturer	Raffaele Carli Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/First
Tentative Calendar	23-1-2026 15:30 18:00 26-1-2026 8:30 11:00 28-1-2026 9:30 12:00 28-1-2026 14:30 17:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course aims at providing PhD students with modeling and methodological tools for formulating and solving large-scale optimization problems with a focus on the use of duality theory. During the course several optimization problems will be formalized, particularly referred to relevant issues within management and industrial engineering. Problem definition and resolution will be also implemented in simulation and engineering software (Matlab). The final goal is to provide PhD students with the necessary background for starting research in the field of duality-based decentralized and distributed optimization techniques to be applied to large-scale systems. Each lesson consists in lectures, numerical examples, simulation and analysis of case studies.
Room	The course will be held online via on Microsoft Teams. Please register here: https://politecnicobari-my.sharepoint.com/:x:/g/personal/raffaele_carli_poliba_it/IQDMgCd1EJA6RKJ-EGptlJJvARgjm1JxCVdTT-fNsrq-rI?e=8qe4vP&wdLOR=c20D0B6E8-F1DA-4188-A3D4-65D12D2445CE For any information, please contact: raffaele.carli@poliba.it

DAUSY

Course title	Non-integer order systems and controllers
Lecturer	Guido Maione Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/First
Tentative Calendar	9-2-2026 15:00 17:00 10-2-2026 15:00 17:00 11-2-2026 15:00 17:00 12-2-2026 15:00 17:00 13-2-2026 15:00 17:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course concerns non-integer-order systems. These systems can propose engineering solutions to modeling and control problems that often improve those based on integer-order calculus. Basic tools of fractional calculus are introduced, and some methods and models are described for different engineering fields. Models for practical applications are proposed. Moreover, approaches to design and realize non-integer-order (fractional-order) controllers are described. These controllers show higher flexibility, increased robustness, and ability to obtain a better trade-off between stability and dynamic performance with respect to widespread PID controllers. As case-studies, the course uses applications in automotive and mechatronic systems.
Room	The course will be held online via on Microsoft Teams. Please register here: https://teams.microsoft.com/l/team/19%3A_yd24Hr6sFwK1y_NxYk4bFmZ1xykQdIM1FMkOXukQ81%40thread.tacv2/conversations?groupId=dcbd3694-b77c-40db-9201-6d5206738c1e&tenantId=5b406aab-a1f1-4f13-a7aa-dd573da3d332 For any information, please contact: guido.maione@poliba.it

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DAUSY

Course title	Deep Reinforcement Learning for Control of Autonomous Systems
Lecturer	Gaetano Volpe Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	First/Second
Tentative Calendar	7-4-2026 9:30 12:00 9-4-2026 9:30 12:00 14-4-2026 9:30 12:00 16-4-2026 9:30 12:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	Reinforcement learning deals with solving sequential decision problems when minima prior information is available. Solving sequential decision problems means finding their optimal control policies. Using reinforcement learning algorithms, the optimal policy is learned through the cooperation between the agent (or controller) and the system to be controlled. Deep Reinforcement Learning (DRL) is a subfield of machine learning that combines reinforcement learning (RL) and deep learning. The course will propose the main modeling frameworks, investigate the most relevant deep reinforcement learning techniques and show some interesting applications.
Room	The course will be held online via on Microsoft Teams. Please register here: https://teams.microsoft.com/l/team/19%3AJjryGwLcrzhck0UAsK1aKpcqK-FUQtQypoUhZ8ukGmwE1%40thread.tacv2/conversations?groupId=7c83cb73-4ff2-4154-8904-820e4431ff63&tenantId=5b406aab-a1f1-4f13-a7aa-dd573da3d332 For any information, please contact: gaetano.volpe@poliba.it

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DAUSY

Course title	Control and Security of Cyber Physical Systems
Lecturer	Ruotian Liu Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/Second
Tentative Calendar	17-3-2026 15:00 17:30 18-3-2026 15:00 17:30 24-3-2026 15:00 17:30 25-3-2026 15:00 17:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The aim of the course is to show the importance of control and security in Cyber Physical Systems (CPSs). CPSs are systems where a decision making(cyber/control)component is tightly integrated with a physical system(with sensing/actuation) to enable real-time monitoring and control. Therefore, control and security are crucial issues for commissioning these systems and for improving competitiveness of companies. In this context, the study of opacity is a fundamental notion to determine if an industrial "secret" can be discovered by a malicious observer (intruder).
Room	The course will be held online via on Microsoft Teams. Please register here: https://docs.google.com/forms/d/e/1FAIpQLScynU8Fso6442f4A2hqdTMzbiC1aiCa4_qEctlgduqAX9nqJQ/viewform?usp=publish-editor For any information, please contact: ruotian.liu@poliba.it

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DAUSY

Course title	Simulation Systems for Engineering Applications
Lecturer	Nicola Mignoni Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	First/Second
Tentative Calendar	2-3-2026 10:00 12:30 4-3-2026 10:00 12:30 6-3-2026 10:00 12:30 9-3-2026 10:00 12:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course shall address the basis of simulation techniques for engineering applications, with a focus on the underlying mathematical formalism. At end of this course students will be able to deal with system modeling and to implement simulation models in engineering tools (e.g., Python, Matlab). Each lesson shall consist in lecture and numerical examples.
Room	The course will be held online via on Microsoft Teams. Please register here: https://politecnicobari-my.sharepoint.com/:x:/g/personal/nicola_mignoni_poliba_it/IQCFvb3YWm1YTpvoImGwDGkmASlLWdnF0uok_fuAmTZwG9k?e=zat6Jv&wdLOR=cE185D907-49AD-4697-B309-98EFFD9D8575 For any information, please contact: nicola.mignoni@poliba.it

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DAUSY

Course title	Modeling and Simulation of Smart Energy Systems
Lecturer	Michele Roccotelli Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	First/Second
Tentative Calendar	14-9-2026 10:00 12:30 15-9-2026 10:00 12:30 16-9-2026 10:00 12:30 17-9-2026 10:00 12:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course aims at providing PhD students with modeling and methodological tools for formulating and solving large-scale optimization problems with a focus on the use of duality theory. During the course several optimization problems will be formalized, particularly referred to relevant issues within management and industrial engineering. Problem definition and resolution will be also implemented in simulation and engineering software (Matlab). The final goal is to provide PhD students with the necessary background for starting research in the field of duality-based decentralized and distributed optimization techniques to be applied to large-scale systems. Each lesson consists in lectures, numerical examples, simulation and analysis of case studies.
Room	The course will be held online via on Microsoft Teams. Please register here: https://politecnicobari-my.sharepoint.com/:x:/g/personal/michele_roccotelli_poliba_it/IQB5YSW0z4oOR7pf3WGvD_PfAZf7DmLKF2oeUhxzH4n1yCc?e=9b6bdN&wdLOR=c72E87F7B-A0A5-4994-966B-B0C366D01E5D For any information, please contact: michele.roccotelli@poliba.it

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DAUSY

Course title	Game Theory for Controlling Autonomous Systems
Lecturer	Paolo Scarabaggio Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/Second
Tentative Calendar	23-6-2026 13:30 16:00 24-6-2026 13:30 16:00 25-6-2026 13:30 16:00 26-6-2026 13:30 16:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course is designed to provide PhD students with the necessary modeling and methodological tools for analyzing and designing algorithms to solve game equilibrium problems. The course will include lectures, numerical examples, simulations, and analysis of case studies.
Room	The course will be held online via on Microsoft Teams. Please register here: https://dclab.poliba.it/people/paolo-scarabaggio/game-theory-for-controlling-autonomous-systems/ For any information, please contact: paolo.scarabaggio@poliba.it

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DAUSY

Course title	Modeling and simulation of biosystems
Lecturer	Alessandro Borri CNR
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	First/First
Tentative Calendar	11-2-2026 11:30 13:30 12-2-2026 11:30 13:30 13-2-2026 11:30 13:30 16-2-2026 10:30 13:30 17-2-2026 11:30 13:30 18-2-2026 11:30 13:30 19-2-2026 11:30 13:30 20-2-2026 11:30 13:30 23-2-2026 10:30 13:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course provides mathematical tools to model, analyze, simulate, and control biological and medical systems, primarily within a deterministic framework. By the end of this course, students will be able to model such systems and implement simulation models using Matlab. Note: Although Course “Modeling and simulation of biosystems” (Prof. Borri) and Course “Dynamical stochastic models of biological systems” (Prof. Palumbo) may be followed independently, they have been conceived as a single module divided into two parts, both dealing with mathematical models for biological systems: the former focuses on deterministic approaches, while the latter focuses on stochastic approaches.
Room	The course will be held online via on Microsoft Teams. Please register here: https://forms.gle/BbFqKR77UeMtBfdp6 For any information, please contact: alessandro.borri@iasi.cnr.it

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DAUSY

Course title	Dynamical stochastic models of biological systems
Lecturer	Pasquale Palumbo Università di Milano Bicocca
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	First /First
Tentative Calendar	24-2-2026 10:30 13:00 25-2-2026 10:30 13:00 26-2-2026 10:30 13:00 27-2-2026 14:30 17:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course gives the mathematical tools to model and analyze most common biological frameworks such as chemical reactions and gene transcription networks, according to the stochastic approach of the Chemical Master Equations. Note: Although Course "Modeling and simulation of biosystems" (Prof. Borri) and Course "Dynamical stochastic models of biological systems" (Prof. Palumbo) may be followed independently, they have been conceived as a single module divided into two parts, both dealing with mathematical models for biological systems: the former focuses on deterministic approaches, while the latter focuses on stochastic approaches.
Room	The course will be held online on Webex: https://unimib.webex.com/meet/pasquale.palumbo Please register here: https://docs.google.com/forms/d/e/1FAIpQLSdHGIxB4AsEx-zzzOeK7W1JK-Wn2RrdA7o7l8gdsmk81JVc-Q/viewform?usp=sharing&ouid=117862340414634942756 For any information, please contact: pasquale.palumbo@unimib.it

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DAUSY

Course title	Data-driven fault diagnosis and fault prognosis
Lecturer	Riccardo Felicetti Università Politecnica delle Marche
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/Second
Tentative Calendar	5-5-2026 10:30 13:00 7-5-2026 10:30 13:00 12-5-2026 10:30 13:00 14-5-2026 10:30 13:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This module aims at providing PhD students with the main concepts of data-driven fault diagnosis and fault prognosis which are at the base of modern condition-based and predictive maintenance. During the module, the students will learn how to apply a data-driven workflow to solve real case studies and to adapt it to the specific cases of fault diagnosis and fault prognosis. The workflow will include data processing, feature extraction and model training, with some insights on deployment complexity; problem resolution will also be implemented by using a common engineering software (MATLAB). The final goal is to provide PhD students with the necessary background to process sensors data and use them to monitor the condition of a physical system, classify possible undesired behaviours and eventually estimate the remaining useful life of specific components. Each lesson consists in lectures, numerical examples and analysis of case studies.
Room	The course will be held online via on Microsoft Teams. Please register here: https://teams.microsoft.com/l/meetup-join/19%3ameeting_N2E2NTEzYzctNTk2Ni00YzUzLWIxZWYtNzgwOGE1NDliZTM1%40thread.v2/0?context=%7b%22Tid%22%3a%22117b418d-fb21-416f-a85f-1e9ff725bf2c%22%2c%22Oid%22%3a%2210905c74-e7b9-435c-8cfe-a91e8c23e0fe%22%7d For any information, please contact: r.felicetti@univpm.it

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DAUSY

Course title	Gaussian processes for modeling and control of robotics systems
Lecturer	Alberto Dalla Libera Università di Padova
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/First
Tentative Calendar	27-01-26 14:00 16:00 29-01-26 14:00 16:00 30-01-26 14:00 16:00 02-02-26 14:00 16:00 04-02-26 14:00 16:00 06-02-26 14:00 16:00 11-02-26 14:00 16:00 13-02-26 14:00 16:00 16-02-26 14:00 16:00 18-02-26 14:00 16:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course shall address the basis of Gaussian Process Regression applied to modeling and control of robotic manipulators. At end of this course, students will be able to apply Gaussian Process Regression to the following problems: ▪ Inverse dynamics identification; ▪ Estimation of forward dynamics model to simulate the evolution of a robotic system; ▪ Use such models to derive a controller. Lesson shall consist in lecture and numerical examples in MATLAB and Python.
Room	The course will be held online. Please register here: https://docs.google.com/spreadsheets/d/1J4XpICQe8H2wJhqs_wFZOI5ai2_DEq01e4qXwxJW8N0/edit?usp=sharing For any information, please contact: alberto.dallalibera@unipd.it

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DAUSY

Course title	Human autonomous system interaction
Lecturer	Sabrina Iarlori Università Politecnica delle Marche
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/First
Tentative Calendar	17-4-2026 10:00 12:00 24-4-2026 10:00 12:00 8-5-2026 10:00 12:00 15-5-2026 10:00 12:00 22-5-2026 10:00 12:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course aims at providing PhD students with the main concepts of the well-known technology for improving human-autonomy interaction with a special focus on autonomous systems. It is especially focused on technology and case studies relevant to complex, applied environments in which people interact with autonomous systems regularly, particularly in the context of ambient assisted living. The course focuses on approaches that include task inputs from humans: how to model humans and their tasks and at what level of details. Moreover, the human in-the loop approach will be introduced as a new scenario to facilitate the goal achievement, to reduce the anomalies and the unexpected responses from the system or inappropriate responses by the human to enhance human safety. New human-system engineering techniques are needed to ensure autonomous systems will be smoothly and readily adopted into society. Autonomous systems that work together in the environment should integrate the connections and interactions between them, over networks, with the physical environment, and with humans must be assured, resilient, productive, and fair in the autonomous future. Autonomous systems should be analysed including concept, context, requirements, design, integration, operationalization, validation, testing and evaluation. During the course, the students will learn how the human-autonomous system interaction is achieved and how it is articulated. The workflow will include data processing, feature extraction and model training for human-robot interaction tasks, with some insights on deployment complexity; problem resolution will also be proposed by using a common engineering software (MATLAB), and the ROS (Robot Operating System). Each lesson consists in lectures, numerical examples and analysis of case studies.
Room	The course will be held online via on Microsoft Teams. Please register here: https://forms.office.com/Pages/ResponsePage.aspx?id=jUF7ESH7b0GoXx6f9yW_LC3dsfm95klHuxc-_D8QUCpUMVk1OFJIREtERDgxREI5NFhSODVPUFRJTSQlQCN0PWcu For any information, please contact: s.iarlori@staff.univpm.it

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DAUSY

Course title	Intelligent Supervisory Systems
Lecturer	Silvio Simani Università di Ferrara
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/Second
Tentative Calendar	2-3-2025 14:30 17:00 5-3-2026 14:30 17:00 6-3-2026 14:30 17:00 9-3-2026 14:30 17:00 12-3-2026 14:30 17:00 13-3-2026 14:30 17:00 16-3-2026 14:30 17:00 19-3-2026 14:30 17:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course aims to offer a foundation of intelligent supervisory system techniques and their application in various real-world domains and how to implement a solution with “intelligent” functionality. Students will learn to judge when intelligent functionality and artificial intelligence may be a good solution for a problem and be able to choose suitable artificial intelligence methods and techniques. Students will also acquire knowledge enabling them to develop the necessary skills to design and implement an intelligent supervisory system.
Room	The course will be held online on Google Meet: meet.google.com/cid-xmdz-bez Please register here: https://forms.gle/nDVsRvn3X39jfiov9 Web page: http://www.silviosimani.it/DAUSY-course-Simani-ISS-2026.html For any information, please contact: silvio.simani@unife.it

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DAUSY

Course title	Introduction to autonomous systems
Lecturer	Nicola Mignoni Politecnico di Bari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/Second
Tentative Calendar	6-4-2026 10:00 12:30 8-4-2026 10:00 12:30 10-4-2026 10:00 12:30 13-4-2026 10:00 12:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course aims at providing PhD students with the fundamental principles, technologies, and applications related to autonomous systems.
Room	The course will be held online via on Microsoft Teams. Please register here: https://politecnicobari-my.sharepoint.com/:x:/g/personal/nicola_mignoni_poliba_it/IQB31VWsqW4AT584q_14zKKAAYvViANSxRm88cG8vPPWjz4?e=WGIQk5&wdLOR=cDB0EF9DF-366E-4245-8057-F19475EE4F05 For any information, please contact: nicola.mignoni@poliba.it

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DAUSY

Course title	Linear algebra for control applications
Lecturer	Matthias Pezzuto Università di Padova
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/Second
Tentative Calendar	9-6-2026 10:00 12:00 10-6-2026 10:00 12:00 11-6-2026 10:00 12:00 16-6-2026 10:00 12:00 17-6-2026 10:00 12:00 18-6-2026 10:00 12:00 23-6-2026 10:00 12:00 24-6-2026 10:00 12:00 25-6-2026 10:00 12:00 30-6-2026 10:00 12:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course will introduce advanced linear algebra tools that are commonly used in many applications in Control and System Theory. The course will address this topic from different perspective: 1. Theory with formal proofs of many results, 2. Algorithms to understand the most common algorithms used in MATLAB or Python for linear algebra, Implementation via MATLAB of algorithms and performance evaluation on large data sets.
Room	The course will be held online. Please register here: https://forms.gle/3TBdJLL5QZULaDXL8 For any information, please contact: matthias.pezzutto@unipd.it

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DAUSY

Course title	Linear and nonlinear Kalman filtering: theory and applications
Lecturer	Marco Todescato Fraunhofer Italia Research
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/Second
Tentative Calendar	27-4-2026 10:30 12:30 4-5-2026 9:30 12:30 11-5-2026 9:30 12:30 18-5-2026 9:30 13:30 25-5-2026 9:30 13:30 1-6-2026 9:30 13:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	This course aims to provide both theoretical and practical tools to tackle estimation problems encountered in several areas of engineering and science. In particular, it is shown how to formulate such estimation problems as instances of a general dynamical system state estimation problem and how to derive the mathematical solution of the latter problem. Then it is shown that, for a linear Gaussian system, such a solution yields the well known Kalman filter. Further, approximate techniques (e.g. extended and unscented Kalman filters, particle filter, etc.) are presented for the case of nonlinear and/or non-Gaussian systems, for which an exact closed-form solution cannot be found. To conclude the theoretical part, theoretical limitations (i.e. the Cramer-Rao lower bound) on the quality of estimation are discussed. In the final part of the course, we illustrate some applications of linear/nonlinear Kalman filtering (e.g., tracking, robotic navigation, environmental data assimilation).
Room	The course will be held online via Microsoft Teams: https://teams.microsoft.com/l/meetup-join/19%3ameeting_ZjQ3NmU3ZmUtNzMzYy00ODJkLWJhNzktZDAzMmJiZjdlZDcz%40thread.v2/0?context=%7b%22Tid%22%3a%228dee6139-b855-464d-bad5-3e579946a1b3%22%2c%22Oid%22%3a%225a0b3bb1-b2f0-49f8-b1a4-694fc880f6eb%22%7d Meeting ID: 389 555 689 053 48 Passcode: dR69ST3U For any information, please contact: marco.todescato@fraunhofer.it

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DAUSY

Course title	Optimal control for Climate change and air quality
Lecturer	Claudio Carnevale Università di Brescia
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	First/Second
Tentative Calendar	1-7-2026 9:30 12:30 2-7-2026 9:30 12:30 3-7-2026 9:30 12:30 6-7-2026 9:30 12:30 7-7-2026 9:30 12:30 8-7-2026 9:30 12:30 9-7-2026 9:30 11:30
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course will address the fundamentals of the modelling and control of real-world systems, presenting the application of control theory to climate change and air quality. Each lesson shall consist in lecture and numerical examples.
Room	The course will be held online. For any information, please contact: claudio.carnevale@unibs.it

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DAUSY

Course title	Learning in multi-agent systems
Lecturer	Nicola Bastianello KTH Royal Institute of Technology
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/Second
Tentative Calendar	13-4-2026 14:00 16:00 14-4-2026 14:00 16:00 20-4-2026 14:00 16:00 21-4-2026 14:00 16:00 27-4-2026 14:00 16:00 28-4-2026 14:00 16:00 4-5-2026 14:00 16:00 5-5-2026 14:00 16:00 11-5-2026 14:00 16:00 12-5-2026 14:00 16:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The aim of the course is to provide a thorough overview of learning and optimization in multi-agent systems. At the end of the course, students will be familiar with applications, with the challenges of decentralized learning, and the current state-of-the-art solutions. Additionally, they will have an overview of current research trends and opportunities. Lessons will merge theoretical lectures and numerical examples (using Python).
Room	The course will be held online. Please register here: https://sites.google.com/view/dausy2026multiagent For any information, please contact: nicolba@kth.se

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DAUSY

Course title	Non-linear Control
Lecturer	Karl Dietrich von Ellenrieder Libera Università di Bolzano
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credits (ECTS)
Year/Semester	Second/Second
Tentative Calendar	8-6-2026 14:00 16:00 9-6-2026 14:00 16:00 10-6-2026 14:00 16:00 11-6-2026 14:00 16:00 12-6-2026 14:00 16:00 15-6-2026 14:00 16:00 16-6-2026 14:00 16:00 17-6-2026 14:00 16:00 18-6-2026 14:00 16:00 19-6-2026 14:00 16:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course introduces analytical tools for the analysis and design of nonlinear control systems. At the end of the course students will understand how to analyze the stability of nonlinear dynamic systems and knowledge of some of the main approaches for designing nonlinear controllers. Basic engineering examples and Matlab exercises are provided.
Room	The course will be held online. Please register here: https://forms.gle/p6irEAtqUm7oSoq8A For any information, please contact: karl.vonellenrieder@unibz.it

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DAUSY

Course title	Variable Structure Control
Lecturer	Elio Usai Università di Cagliari
Scientific Discipline Sector	IINF-04/A
Hours of instruction	10 hours
CFU	1 credit (ECTS)
Year/Semester	Second/First
Tentative Calendar	23-2-2026 15:00 17:00 24-2-2026 15:00 17:00 25-2-2026 15:00 17:00 26-2-2026 15:00 17:00 27-2-2026 11:00 13:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	Variable Structure Control (VSC) is a control technique who force a dynamical system to behave as a Variable Structure System (VSS) whose characteristics satisfy the required performance, in spite of a class of uncertainties in the system dynamics and external disturbances. In particular the system is forced to reach and remain constrained onto a properly chosen surface of the state space such that the movement on such a surface, i.e., the Sliding Mode (SM), is invariant and corresponds to specifications. The lectures will present the general theoretic and applicative framework of VSC with SMs, presenting it in the more general vision of the control systems. Some of the mathematical tools to analyze and design a VSC with SM will be presented and discussed, also by means of simple examples. The limits of the resulting switching control, the tools to analyze the approximate behavior and the approaches to mitigate the so-called chattering phenomenon will be presented and discussed. Finally, some applications of VSC to real systems and to observer design will be presented.
Room	The course will be held online. For any information, please contact: elio.usai@unica.it

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Courses Offered by Universities within the DAUSY Network

Università di Modena e Reggio Emilia

Course title	Smart Sensing from Noisy Data: Estimation & Filtering
Lecturer	Laura Giarrè Università di Modena e Reggio Emilia
Scientific Discipline Sector	IINF-04/A
Hours of instruction	12 hours
CFU	3 credits (ECTS)
Tentative Calendar	26-1-2026 11:00 13:00 26-1-2026 15:00 17:00 27-1-2026 10:00 13:00 27-1-2026 15:00 17:00 29-1-2026 10:00 13:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	Introduction: Smart sensing from Noisy Data, ML vs Estimation, Parametric vs Nonparametric Estimation Kalman filtering, Bayesian approach, and ML, Applications of Kalman Filtering Literature on Kalman filtering Estimation Theory: Parametric estimation, Properties of estimators, Minimum Variance estimator Maximum likelihood estimators, Bayesian estimation Least Squares Algorithm (RLS, LMS): Linear regressions, LS Estimates: Statistical properties, Bias, variance, covariance BLUE estimation, RLS algorithms, LMS algorithms The relation between Kalman and RLS Kalman Filtering: Markov Processes, Linear Stochastic Systems, State Estimation Kalman filter, Kalman filter in Prediction form, Asymptotic Properties of Kalman Filter, EKF
Room	The course will be held online via on Microsoft Teams. https://teams.microsoft.com/meet/34688126000486?p=e0ut30OhGvEGCGp49e For any information, please contact: laura.giarre@unimore.it

Università di Firenze

Course title	Multiagent multiobject estimation
Lecturer	Luigi Chisci Università di Firenze
Scientific Discipline Sector	IINF-04/A
Hours of instruction	20 hours
CFU	2 credit (ECTS)
Tentative Calendar	2-2-2026 9:00 13:00 3-2-2026 9:00 13:00 5-2-2026 9:00 13:00 9-2-2026 9:00 13:00 10-2-2026 9:00 13:00
SUMMARY /GOAL **Syllabus** **Bibliography** **Examination method**	The course will provide an overview of advanced research in estimation, specifically concerning the two topics of multi-agent and multi-object estimation. Multi-agent estimation deals with a network of agents with sensing, processing and communication capabilities that aim to cooperatively monitor a given system of interest. Multi-object estimation aims to detect an unknown number of objects present in a given area and estimate their states. Special attention will be devoted to the Kullback-Leibler paradigm for fusion of possibly correlated information from multiple agents and on the random-finite-set paradigm for the statistical representation of multiple objects. Applications to distributed cooperative surveillance, monitoring and navigation tasks will be discussed. Recalls on Bayesian filtering. Network modeling and Bayesian approach to multi-object estimation. Kullback-Leibler fusion and its properties. Scalable fusion via consensus. Distributed Kalman filtering with guaranteed stability. Event-triggered communication for enhanced efficiency. Random-finite-set (RFS) modeling of multi-objects. Multi-object filtering. Multi-object fusion. Applications to multi-target tracking, simultaneous localization and mapping (SLAM), source detection and localization.
Room	The course will be held online: 2-2-2026 meet.google.com/wvp-wwvf-fta 3-2-2026 meet.google.com/ofy-aryt-tob 5-2-2026 meet.google.com/zow-yfzv-txk 9-2-2026 meet.google.com/eau-huix-kzq 10-2-2026 meet.google.com/qcu-dujq-ujb Please register here: https://docs.google.com/forms/d/e/1FAIpQLSfEyYlDnrim46u_PMAmP6i56-H91Rf7xs_3GNfsXaWGyJ-GmQ/viewform For any information, please contact: luigi.chisci@unifi.it