Manifesto of Studies 2026-27
PhD in Electronics, Computer Science and Electrical Engineering

The teaching activities of the doctoral course are organised into eight curricula:

Photonics,
Microwave Technologies,
Communication Systems,
Artificial Intelligence and Computer Vision
Cyber Physical Systems
Automation
Electrical Engineering
Mechatronics and Robotics

At the enrolment stage, each student is associated to a curriculum on the basis of his/her background and of the theme of the research project assigned by the tutor.
Each student must earn a minimum of 10 credits by attending and successfully completing the examinations for courses included in the curriculum proposed by the PhD Board. In agreement with the tutor, the student may include courses from other curricula in his/her teaching plan if these are consistent with the training project.

Photonics

Numerical methods for the design of photonic and microwave components

Lecturers: M. Bozzi, C. Lacava, A. Agnesi
The purpose of the course is to provide students with numerical skills for the design of photonic and microwave devices and components in the guided propagation regime or in free space. The course also includes presentation and in-depth study of the main software adopted in scientific and commercial applications.
Course credits: 6,6 – second semester

Terahertz Transceivers: Principles, Challenges, and Emerging Applications

Lecturer: Dajana Cassioli, Università de L'Aquila
Objectives: The course will explore the operating principles of THz signal generation, modulation, transmission, and detection, with particular emphasis on state-of-the-art transceiver architectures. Key enabling technologies, including photonic-assisted techniques, electronic THz sources, and integrated solutions, will be discussed. Attention will also be given to challenges such as propagation losses, hybrid analogue-digital processing, and system integration. The course will also examine emerging applications of THz transceivers in high-speed wireless communication and sensing systems, highlighting current research trends and future directions in the field.
Course credits: 2,2 – second semester

Microwave Technologies

Advanced Topics in RF and Microwave Technology

Lecturers: M. Bozzi and L. Perregrini

Objectives: The course aims to provide an overview on the emerging research topics in microwave and antenna technology, with particular emphasis on integration and manufacturing technology for RF and microwave components and systems, microwave sensors for material characterization, and industrial and medical applications of microwaves.

Course credits: 4 – second semester

Numerical methods for the design of photonic and microwave components

Lecturers: M. Bozzi, C. Lacava, A. Agnesi

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Course credits: 6,6 – second semester

Communication Systems

Terahertz Transceivers: Principles, Challenges, and Emerging Applications

Lecturer: Dajana Cassioli, Università de L'Aquila

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Course credits: 2,2 – second semester

Artificial Intelligence and Computer Vision

AI-Security

Lecturers and coordinators: A. Nocera, C. Cusano

Cybersecurity deals with technologies, processes, and control mechanisms to protect devices, networks, and data from malicious attackers. As cyberattacks evolve overtime and grow in volume and complexity, Artificial Intelligence (AI) techniques have shown to be fundamental solutions to stay ahead of threats. Although such techniques, typically involving machine learning and deep learning solutions, are key factors to develop new generation defence mechanisms, more and more AI-driven menaces are also developed by attackers. This course provides an overview of cybersecurity and privacy concepts, introduces the main technologies adopted in this context, and then shows practical examples of AI-driven attack and defence approaches.

Course credits: 5 – first semester

Gaze-Enhanced Intelligent Human-Computer Interaction

Lecturer: M. Porta

Simple and effective communication with the computer is an increasingly relevant requirement, and recent developments in the fields of Artificial Intelligence and machine perception can contribute significantly to this aim. In the context of Intelligent User Interfaces (IUIs), Eye Tracking plays an important role, providing the computer with the sensory capabilities necessary for the perception of the user's gaze.

This short course offers an overview of the characteristics and applications of Human-Computer Interaction (HCI) enhanced by eye input. Through the analysis of existing solutions and current trends, the student will discover the potential of user interfaces that implement gaze-based implicit and explicit communication.

Course credits: 2,4 – first semester

Artificial Intelligence Risk Management

Lecturers: P. Giudici

The aim of the course is to introduce AI risk management metrics: Accuracy, Robustness, Explainability, Fairness, Sustainability, and show how to calculate them in specific AI applications. This is line with the recent development in international regulations and standards, such as the EU AI Act and ISO/IEC 22989.

Course credits: 3 – first semester

Cyber Physical Systems

AI-Security

Lecturers and coordinators: A. Nocera, C. Cusano

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Course credits: 5 – first semester

Real-time Physical Systems (Real-time scheduling for load shifting)

Lecturers: T. Facchinetti

The objective of the course is to illustrate the application of real-time scheduling algorithms to the scheduling of power loads in an energy system, with applications to building automation, load balancing and peak load shaving.

Course credits: 3 – second semester

Automation

Systems and control colloquia

Lecturers: E.M. Aiello, G. De Nicolao, A. Ferrara, G. Galuppini, L. Magni, C. Toffanin

The course aims at presenting methodologies and applications widely used in the fields of Identification and Control of Dynamic Systems. PhD students will participate in seminars held by academic and/or industry experts, as well as experience a flipped learning approach where they become active in sharing their thoughts and research experiences during open discussions. This

combined approach will broaden their technical knowledge and ultimately lead to an improvement in their capabilities to present, discuss and critically evaluate scientific topics.
Course credits: 5 - first semester

A Smart Grid for Distributed Energy Management.

Coordinators: P. Di Barba, F. Benzi
Nowadays, the availability of renewable and innovative energy sources makes the bidirectional energy flow between the grid and distributed sources a key concept, thus requiring a smarter control (Smart Grid). The course approach includes such relevant issues as a safe energy provision and environment sustainability, also asking for a systematic use of economic issues implied with the energy market. In this respect, the course aims at giving a general overview of systems and devices, characterizing the smart grid, as well as an insight on models, algorithms and strategies for the optimal distribution of energy resources. Smart Grid takes advantage of recent enabling technologies (IoT approach, cloud services, novel control strategies) and covers a large spectrum of disciplines, asking for a coordinated approach and merging different skills covered in this proposal by expert speakers.
On the other hand, all these topics are not yet fully considered in engineering curricula, so that the proposed Course aims at bridging the gap. The course addresses to a broad audience including PhD students and young researcher, but also professional engineers operating in the industry area.
Course credits: 7,4 – second semester

Electrical Engineering

A Smart Grid for Distributed Energy Management

Coordinators: P. Di Barba, F. Benzi
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Lecturers: T. Facchinetti
The objective of the course is to illustrate the application of real-time scheduling algorithms to the scheduling of power loads in an energy system, with applications to building automation, load balancing and peak load shaving.
Course credits: 3 – second semester

Mechatronics and Robotics

Advanced Robotics

Coordinator: H. Giberti

The aim of the course is to provide an overview of robotics frontier technologies and applications mainly for the industrial sector.

Course credits: 4 – second semester