

## **Faculty of Science and Technology**

### **Ph.D. Programme in ADVANCED-SYSTEMS ENGINEERING**

**Website:** <https://www.unibz.it/en/faculties/sciencetechnology/phd-advanced-systems-engineering/>

**Duration:** 3 years

**Academic year:** 2022/2023

**Start date:** 01/11/2022

**Official programme language:** English

#### **Programme contents**

This international PhD program trains a new generation of researchers who focus on Mechanical and Manufacturing Systems, Automation and Electronic Systems and Computer Systems to carry out independent research in the areas of Advanced-Systems Engineering and to give them the opportunity to transfer and exchange knowledge with national and international research centers and industries.

The three-year PhD programme focuses on the study and development of advanced and intelligent systems through an interdisciplinary approach that responds to recent technological developments (e.g., Cyber-Physical-Systems, Industry 4.0, Internet of Things) by integrating the disciplines of mechanical engineering, manufacturing engineering, information engineering and computer science. They are supported by specific skills in mathematics and artificial intelligence.

Ph.D. student projects pertain to the following research areas, which are actively pursued by research groups at unibz on a long-term basis, and are considered in the Ph.D. on Advanced-Systems Engineering:

#### **Mechanical-and-Manufacturing-Systems Engineering**

- Mechanical and Mechatronic Systems
- Advanced Manufacturing Technologies
- Mechanical Engineering Design and Optimization
- Production Systems and Management,
- Smart Factory

#### **Automation and-Electronic-Systems Engineering**

- Autonomous systems
- Human-in-the-loop systems
- Thin-film devices and sensors
- Flexible and wearable electronics, smart textiles
- Micro and nano technology
- Soft biocompatible sensor systems
- Robotic Systems
- Automatic Control
- Intelligent Sensor/Actor Networks

#### **Computer Systems Engineering**

- Systems of Systems
- Complex Networks
- Distributed Systems and Security
- Self-Adaptive Software Systems

- Development and Operation of IoT Systems
- Operations Research

The main features of the PhD are an interdisciplinary scientific approach and the participation of internationally renowned scientists on the Scientific Committee.

Students will further improve their ability to clearly and to efficiently communicate ideas orally and in writing, as well as to work in research groups. The final thesis must be written in English and shall include translations of its abstract in both German and Italian. Ph.D. students will benefit from the special multilingual opportunities the University offers, which include activities/events in Italian, German and other languages (seminars, elective courses, social events, etc.). The Ph.D. program comprises lectures and research activities that shall be completed at UniBZ, together with some components that may be performed at other universities, in Italy and abroad. Each Ph.D. candidate is required to spend a minimum of 3 months (and up to a maximum of 12 months) abroad conducting a part of their research.

The Ph.D. programme is based on the following activities:

- Each student shall develop and organize a research plan and conduct a thorough literature survey, which includes a summary and analysis of the state-of-the-art of their research topic. The literature survey shall be completed within the first 6 months of the course and shall be performed in consultation with their supervisor and any co-supervisors. At the latest after six months, students must present and defend their research plan in front of the Ph.D. Course Committee.
- Students shall present their research results at one or more international conferences. The related research shall be archived in the accompanying conference proceedings as either a paper or a poster.
- Students shall spend at least three months abroad conducting research.
- Students shall attend compulsory courses focused on analysing and writing scientific articles, as well as other courses, workshops or summer schools that will expand their background and deepen their expertise in topics related to their dissertation. These additional courses shall be approved by the Ph.D. Course Committee. The student must pass any relevant exams to receive course credits.

To be admitted to the final thesis exam, students must have had at least one article accepted for publication in an international, peer-reviewed, Scopus-indexed, journal as the lead author. Exceptions to this rule shall be evaluated and, if appropriate, approved by the Ph.D. Committee.

Note that the program is full-time only and for its duration students are expected to devote their efforts to completing their doctoral project.

### **Ph.D. stages**

The Ph.D. research activities are organized into five milestones, which shall be completed at months 2, 6, 12, 24 and 36 of the program. At the end of each stage, each student shall meet the Ph.D. Committee to present his/her project and results. The Ph.D. Committee shall review and assess each student's work and provide recommendations, as needed.

**Phase 1 (first 2 months):** The Ph.D. Committee shall meet with the students and assign each student a supervisor. Together with the supervisor and any co-supervisors the student shall identify his/her research topic (within the areas listed in this advertisement) and develop a study plan, which

shall be approved by the Ph.D. Committee. Students may start attending courses that are relevant to their individual study plans.

**Phase 2 (2nd-6th month):** After an exhaustive review of the literature concerning his/her subject area, as well as having completed the first steps in the research topic activity, each student shall:

- prepare his/her research programme that has to be approved by the Ph.D. Committee;
- possibly complete and/or attend courses that are relevant to his/her individual study plan;
- prepare a report of the state of the art of his/her research topic to be reviewed by the supervisor and another researcher nominated by the council.

**Phase 3 (6th -12th month):** Each student shall continue performing research on his/her topic and can also attend courses, summer schools, seminars, or conferences. Each student shall report, in both written and oral, form his/her first-year activities, present the research programme he/she plans to conduct abroad and propose a co-supervisor at the foreign university or research centre to the ASE Ph.D. Committee.

**Phase 4 (12th -24th month):** Each student continues his/her research and finishes any courses that have been started. At this stage, it is likely that some of this time will be spent abroad.

**Phase 5 (24th-36th month):** Each student shall finish: his/her research; any remaining required work abroad; writing and submitting the required journal manuscript(s) for publication in international peer-reviewed journal(s); and complete his/her (draft) thesis. To be admitted to the final exam, each student shall present a report about his/her third-year activities and final thesis to the Ph.D. Committee.

During Phases 4 and 5, students are also expected to attend international conferences to present the results of the activities developed within the Ph.D. programme, and to start the preparation of the manuscript(s) for publication in peer-reviewed journals. Each student shall report in both written and oral form his/her second-year activities to the Ph.D. Committee.

**Proposed General Research topics**

<b>Project</b>	<b>Supervisor</b>
Dynamics and diffusion on complex networks	Bertotti
Structure and properties of complex networks	Bertotti
Development of a smart system steering the engineering design process through the real-time provision of inspiration sources	Borgianni
Use of new technologies to favor users' understanding of products' actual sustainability-related performances	Borgianni
Green and Circular Thin-film Electronics	Cantarella
Ultrathin and Imperceptible Sensors and Electronic Devices	Cantarella
Characterization of the mechanical behavior of engineering materials exploiting numerical approaches and experiments	Concli

Implementation of multi-axial fatigue criteria specifically developed for Additive Manufacturing alloys	Concli
Digital Twin development for Smart Mobile Factories	Dallasega
Development of Data-Driven Aid Systems to support Planning, Scheduling and Monitoring of Projects	Dallasega
Path and motion planning for intelligent vehicles and robots	Frego/Peer
Control and optimization in presence of uncertainties in gamification and game theory	Frego/Peer
Industrial DevOps: Applying DevOps For Software, Hardware, and Firmware	Janes/Russo
Performance Engineering in Industrial Software Engineering	Janes/Russo
Dynamics and diffusion on complex networks	Modanese
Structure and properties of complex networks	Modanese
Thin-film transistors, circuits, and sensors for wearable electronics	Münzenrieder
Smart textiles based on flexible electronics	Münzenrieder
Quality Engineering for AI-driven Edge Cloud Architectures	Pahl
Self-adaptive Microservice Architectures for the Deep Edge	Pahl
Action, plan and intention recognition for supporting decision making and action sharing in human-robot collaboration	Peer
Dynamic models for emotion estimation from physiological signals	Peer
Nanotechnology and nanoparticles for engineered living materials	Petti
Sustainable bio-based electronics for on-plant health monitoring	Petti
Advanced and flexible manufacturing and assembly technologies	Rauch
Biological transformation and bio-intelligent manufacturing	Rauch
CAIS - Collaborative AI-enabled systems	Russo
Edge continuum for distributed charging stations for electric cars	Russo
Optimal motion planning for safe industrial collaborative robotics	Vidoni

Development of smart and efficient mechatronics and robotic solutions for agro-forestry	Vidoni
Controllers for reactive collision avoidance in mobile robotics	von Ellenrieder
Control of high speed underactuated ground vehicles	von Ellenrieder

\* this is only a partial list of available projects, other topics dealing with the research activity of the members of the Ph.D. Committee can be explored.

### **Admission Requirements - Evaluation criteria for examinations/qualifications**

Degrees from the former Italian university system: all

Master (laurea specialistica/magistrale): all

### **Foreign degrees**

Applicants who have a foreign degree must have a university level education of at least five years (or equivalent) and hold the prerequisites listed below.

### **Other:**

The requisites for admission to doctoral programmes are related to an appropriate educational, and/or scientific background, and/or have worked in the Ph.D. program research fields.

Qualifications in engineering and computer science are preferable.

Admission to the program is based on the assessment of applicants through:

- CV and academic qualifications.
- A cover letter explaining the student's motivation for applying to this Ph.D. programme.
- A technical interview.

During the interview, the knowledge of the English language will be also assessed.

The candidates' profile will be evaluated based on the quality, as well as the potential synergy with the research areas of the Ph.D. Programme.

### **To apply for the Ph.D. Programme, applicants shall submit the following documents:**

- A personal statement, written in English (max. 2 pages). In this document, the candidates shall indicate which of the proposed research areas and topics they are interested in. They may mention why they think unibz and this Ph.D. programme is the right place for their tertiary education and research activities.
- Curriculum vitae (CV) (in English and preferably following the EU format, which can be downloaded here <https://europass.cedefop.europa.eu/en/documents/curriculum-vitae>).
- Master's degree certificate or equivalent with final mark and the transcripts of exams taken with their marks (transcript of records). The certification of Italian university titles MUST be substituted by a self-declaration or by the Diploma Supplement.

### **Other documents to be included by applicants, when available:**

- Up to a maximum of 2 reference letters, written in Italian, German or English provided by a university lecturer or a researcher from a research institute, describing the work carried out and its quality. In lieu of letters, the names and institutional contact information of up to 2 professional references can be provided.

- A list of publications (published, being published, or submitted for publication) and the digital copy of at most 3 selected publications from the past 5 years (note that most weight is given to articles indexed in Scopus and/or on the Web of Science).

The application process consists of three stages:

1. The applications are first reviewed for administrative completeness and eligibility by the competent unibz offices.
2. Those complete applications, which fulfill the base admission requirements, are then evaluated by the ASE PhD Programme Evaluation Committee, which shall consider the applicant's CV, cover letter, qualifications (including any publications), and the alignment between the candidate's profile/interests and the Ph.D. Programme research areas. The Evaluation Committee shall then create a list of applicants to be admitted to the 3<sup>rd</sup> stage of the selection process.
3. Each candidate will be interviewed to assess his/her basic/fundamental technical knowledge in one or more of the Ph.D. programme's research areas, as well as her/his ability to orally communicate in English. The interview may be conducted via live video conference, if necessary. The Evaluation Committee shall rank the applicants via a comparative assessment.

The following scores will be awarded:

- up to 10 points for: the applicant's CV, cover letter and qualifications,
- up to 10 points for the appropriateness of the CV regarding the research areas of interest for the Ph.D. programme,
- up to 20 points for the interview.

The final score is the sum of the points awarded for the 3 categories described above, with a max of 40. The final score shall be used to define the ranked list of candidates, and to determine which candidates will be offered a research scholarship. The lowest score to be admitted in the rank-list is 20/40.

**Scholarships financed by external institutions.**

***If interested in one of the scholarships financed by external institutions, the applicant must explicitly state his/her interest in the letter of motivation and application.***

Separate rankings may be drawn up for such grants. In any case, these separate rankings will only include candidates who have already been included in the general ranking of merit and who have a scientific curriculum that is particularly appropriate to the project in question.

The final ranked list will be published on the unibz website [www.unibz.it](http://www.unibz.it).

**Examination dates**

Description	Date	Place
Personal Interview	19 September 2022  22 September (if needed to accommodate a large number of applicants)	At unibz or via MS Teams according to one's availability - if not otherwise communicated

### Positions and grants

Total number of positions available:	4
Number of positions with other type of support:	3
Number of AR positions (research grants):	1

### PhD scholarship bound to specific research topics/areas:

2 scholarships with bound research topics and minimum 6-months study period abroad and minimum 6-months in company internship according to DM 352/2022 funded by PNRR:

Research topics:

1. Development of advanced control strategies for a 2-axes off – road autonomous vehicle (in collaboration with *Iveco Defense Vehicles*, supervisor Prof. Karl von Ellenrieder)
2. Prediction and Avoidance of Cracks in Sinter Components (in collaboration with GKN PM, supervisor Prof. Angelika Peer)

1 scholarship with bound research topic in collaboration with Schäffler Automotive Bühl GmbH & Co. KG:

Research topic:

1. Computer Vision and AI for automating visual inspection and creating parts' digital twins (supervisors Prof. Oswald Lanz and Prof. Michael Haller)

1 AR position (research grants)

Research topic:

1. Project: SMF4INFRA - Smart Mobile Factory for Infrastructure Projects (Topic: BIM and IoT Integration for Digital Twins in Construction Industry, supervisors Dr. Patrick Dallasega e Dr. Erwin Rauch)