Control Systems Engineering
Preparation of the study plan

INSTRUCTIONS
2023/24
Study Plan
Selection of courses and activities to be completed for graduation. Total formative credit units: 120 – 126

Common mandatory activities (69 cfu)

SYSTEMS THEORY  9 cfu  (Year 1, Semester 1)
MACHINE LEARNING  9 cfu  (Year 1, Semester 1)
DIGITAL CONTROL  6 cfu  (Year 1, Semester 1)
ESTIMATION AND FILTERING  6 cfu  (Year 1, Semester 2)
CONTROL LABORATORY  9 cfu  (Year 1, Semester 2)

FINAL THESIS + INTERNSHIP/RESEARCH TRAINING  21+9=30 cfu
The remaining activities of the study plan (51-57 cfu) can be chosen by:

- selecting one of the 4 suggested paths (Machine Learning, Robotics, Industrial Automation and Complex systems), with automatic approval;

- preparing a customized plan according to the student’s interests. It must be approved by the teaching committee.

All study plans must be submitted via UNIWEB.
Machine Learning Path

**Path Courses**
- Convex Optimization Learning
- Dynamical Systems
- Reinforcement Learning
- Computer Vision

**“Advanced Control”**
- Nonlinear Systems & Control
- Robotics and Control 1
- Adaptive and MPC

**“Methods and Models”**
- Game Theory
- Neural Networks and DL
- Learning from Networks
- Network Dynamical Systems

**“Computation and measurements”**
- Big Data Computing
- Measurements architectures for cyber-physical systems

30 path cfu + 6 control cfu + 15 elective cfu
Robotics Path

Path Courses
- Robotics and Control 1
- Robotics and Control 2
- Convex Optimization
- Computer Vision

“Learning”
- Learning Dynamical Systems
- Reinforcement Learning

“Advanced Control”
- Nonlinear Systems & Control Network
- Dynamical Systems

“Applied”
- Industrial Robotics
- Intelligent Robotics
- Robotics Laboratory

“Industrial”
- Modeling and Control of Electric Drives
- Embedded Real-Time Control
- Measurement Architectures for CPS
- Design of Mechanical Drives

30 path cfu + 6 control cfu + 15 elective cfu
# Industrial Automation Path

<table>
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<tr>
<th>Core Courses</th>
<th>30 path cfu + 6 control cfu +15 elective cfu</th>
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<tbody>
<tr>
<td>Convex Optimization</td>
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<td>Embedded Real-Time Control</td>
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<td>Industrial Automation</td>
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<td>Electric Drives for Automation</td>
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| “Methodological”                  |                                               |
| Learning Dynamical Systems       |                                               |
| Robotics and Control 1           |                                               |

| “Applied”                        |                                               |
| Industrial Robotics              |                                               |
| Computer Vision*                 |                                               |
| Measurement Architectures for CPS|                                               |
| Design of Mechanical Drives      |                                               |

| “Disruptive”                     |                                               |
| Reinforcement Learning           |                                               |
| Information Security             |                                               |
| Computer Vision**                |                                               |
| Adaptive & MPControl             |                                               |
Complex Systems Path

30 path cfu + 6 control cfu
+15 elective cfu

Core Courses
- Learning Dynamical Systems
- Convex Optimization
- Mathematical Physics
- Nonlinear Systems & Control

“System Biology”
- System Biology
- Control of Biological Systems
- Math. Cell Biology

“NL Dynamics”
- Robotics and Control 1
- Robotics and Control 2
- Reinforcement Learning

“Networks”
- Network Dyn. Systems
- Learning from Networks
- Game Theory

“Information”
- Automata, Languages and Computation
- Quantum Information & Computing
- Game Theory
Customized Path and Full Course List

Rules for customized paths: Total credits must be 120-126. 39 CFU are mandatory courses, 30 CFU are thesis+Int./RT. In addition, you need AT LEAST 15 CORE CFU and AT LEAST 15 INTEGRATIVE CFU. Moreover, you must choose 9-15 ELECTIVE CFU from any Master program of UNIPD (including the following list).

Industrial Automation (9cfu CORE)  
Learning Dynamical Systems (9cfu, CORE)  
Robotics and Control 1 (9cfu, CORE)  
Robotics and Control 2 (9cfu, CORE)  
Adaptive and Model Predictive (6cfu, CORE)  
Reinforcement Learning (6cfu, CORE)  
Nonlinear Systems and Control (6cfu, CORE)  
Embedded Real-Time Control (6cfu, CORE)  
Network Systems and Dynamics (6cfu, CORE)  
Network Systems (6cfu, CORE)  
Systems Biology (6cfu, CORE)  
Robotics laboratory (6cfu, CORE)  
Industrial Robotics (9cfu, CORE)  
Design of Mechanical Drives (6cfu CORE)  
Convex Optimization (6cfu, INTEG.)  
Mathematical Physics (9cfu, INTEG.)  
Digital Signal Processing (6cfu, INTEG.)  
Quantum Information and Computing (6cfu, INTEG.)  
Neural Networks and Deep Learning (6cfu, INTEG.)  
Measurement Architectures for Cyber-physical Systems (9cfu, INTEG.)  
Computer Vision (9cfu, INTEG.)  
Computer Vision (6cfu, INTEG.)  
Intelligent Robotics (9cfu, INTEG.)  
Big Data Computing (6cfu, INTEG.)  
Learning from Networks (6cfu, INTEG.)  
Game Theory (6cfu, INTEG.)  
Information Security (6cfu, INTEG.)  
Automata, Languages and Computation (9cfu, INTEG.)  
Control of Biological Systems (6cfu, INTEG.)  
Smart Grids (6cfu, INTEG.)  
Automotive and Domotics (9cfu, INTEG.)  
Stochastic Processes (6cfu, INTEG.)  
Modeling and Control of Electric Drives (9cfu INTEG.)  
Mathematical Cell Biology (6cfu INTEG.)
Customized Path: How to Prepare for UNIWEB

Choose your courses from the list and other masters and organize them in groups:
- **Group C**: Core;
- **Group I**: Integrative;
- **Group M**: *Robotics and Control 2*, if you want to include it. It counts as 6 core and 3 integrative CFU;
- **Group E**: Other master programs (Elective);

**Check 1**: The (sub)total should be in the 51-57 CFU interval. If not, remove or add some;

**Check 2**: Core (Group C) should be at least 15, integrative (Group E) should be at least 15. If not, add CFU in the group;

**Check 3**: Other master programs should be at most 15;

Next, move to Group E (elective) enough exams from those you selected in groups C,I so that:
- E has at least 9 CFU;
- 3 checks above are still satisfied. Group E courses do not count towards Check 2.

Now you should be able to successfully insert this plan in UNIWEB, associating the groups (and subgroups for E) to the different “rules”.
Questions?

More info at:
https://lauree.dei.unipd.it/lauree-magistrali/control-systems-engineering/

Ask for help or suggestions by writing to:
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