



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

30 path cfu + 6 control cfu +15 elective cfu

“Computation and measurements”

Big Data Computing
Measurements architectures
for cyber-physical systems

“Advanced Control”

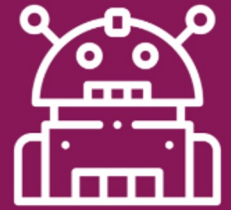
Nonlinear Systems & Control
Robotics and Control 1
Adaptive and MPC

“Methods and Models”

Game Theory
Neural Networks and DL
Learning from Networks
Network Dynamical Systems

Robotics Path

30 path cfu + 6 control cfu + 15 elective cfu



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

Industrial Automation Path



Core Courses

Convex Optimization
Embedded Real-Time Control
Industrial Automation
Electric Drives for Automation

30 path cfu + 6 control cfu + 15 elective cfu

“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 & MPCControl

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 I) 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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