# *Engineering of Industrial Robots*

## General Information

**Number of ECTS Credits**

3

**Module code**

TSM_IndRobot

**Valid for academic year**

2025-26

**Last modification**

2024-10-03

**Coordinator of the module**

Anna Valente (SUPSI, anna.valente@supsi.ch)

**Explanations regarding the language definitions for each location:**

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

|  | Lausanne |  |  | Lugano | Zurich |  |  |
|---|---|---|---|---|---|---|---|
| **Instruction** |  |  |  | **X** E 100% |  |  |  |
| **Documentation** |  |  |  | **X** E 100% |  |  |  |
| **Examination** |  |  |  | **X** E 100% |  |  |  |

**Module Category**

TSM Technical scientific module

**Lessons**

2 lecture periods and 1 tutorial period per week

## Entry level competences

**Prerequisites, previous knowledge**

- Linear algebra
- Basics of mechanics (statics and kinematics)
- Mechanical design (recommended)
- Basic programming skills
- Basics of robotics (recommended)

# Brief course description of module objectives and content

The course targets technical and application challenges related to the design of advanced robotic solutions for industrial and service applications. It addresses the design, engineering and optimization of serial and parallel kinematics robotic arms, as well as of mobile platforms.

The course will cover theoretical content and practical activities of mechanical design, programming and simulation, as well as laboratory experiences with real hardware

Industrial use cases and service use cases will be addressed during the application/laboratory activities, specifically dealing with cutting-edge solutions and challenging markets demanding advanced robotic platform.

The laboratory ctivities will involve the use of industrial robots, cobots, and both commercial and experimental mobile platforms (wheeled and legged), to demonstrate course topics and to support the students in developing their projects and testing some of the designed hardware solutions.

# Aims, content, methods

## Learning objectives and competencies to be acquired

The learning objectives are:

- Ability to select a robotic platform starting from specific use cases requirements as well as productivity and safety KPIs
- Design, engineer, analyze statically and dynamically a robotic solution
- Design accessories (tools, fixturing, sensors), including vision-based perception systems

## Module content with weighting of different components

### Robotics basics review

- Position and orientation
- Kinematics
- Dynamics
- Trajectory and motion planning

### Engineering of arm-type robots
- Problem statement: reference industrial task
- Serial and parallel robot architectures
- Workcell configuration: kinematic model, reach, tools, sensors
- Structural design, computation of inertias
- Design and dimensioning of actuators and transmission mechanisms
- Tool, fixturing, services design
- Motion simulation and optimization
- Design of vision-based sensing solutions

### Engineering of mobile robots
- Problem statement: reference industrial task
- Kinematic models for wheeled robots
- Kinematic models for legged robots
- Robot configuration: kinematic model, tools, sensors
- Locomotion system design
- Path planning and motion simulation
- Design of vision-based navigation system

- Interactive lectures
- Tutorials in presence with lab equipment
- Self-study with exercises and assignments

P. Corke, "Robotics, Vision and Control". Springer Cham, 2nd edition (2017).

B. Siciliano, O. Khatib, "Springer Handbook of Robotics". Springer Berlin, Heidelberg (2008).

# Assessment

The module contains additional performance assessment(s) during the semester. The achieved mark of the additional performance assessment(s) applies to both the regular and the resit exam.

Two assignments given during the course count 30% of the final mark.

**As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.**

**Kind of exam**

Written exam

**Duration of exam**

120 minutes

**Permissible aids**

No aids permitted

**Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.**

**Kind of exam**

Oral exam

**Duration of exam**

30 minutes

**Permissible aids**

No aids permitted