## Syllabus

### Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>“Industrial Collaborative Robotics”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course code</td>
<td></td>
</tr>
<tr>
<td>Scientific sector</td>
<td>Ing-Ind/13</td>
</tr>
<tr>
<td>Degree</td>
<td>LM-33</td>
</tr>
<tr>
<td>Semester</td>
<td>1</td>
</tr>
<tr>
<td>Year</td>
<td>2024</td>
</tr>
<tr>
<td>Academic Year</td>
<td>2023-2024</td>
</tr>
<tr>
<td>Credits</td>
<td>3 ECTS</td>
</tr>
<tr>
<td>Modular</td>
<td>No</td>
</tr>
<tr>
<td>Total lecturing hours</td>
<td>14</td>
</tr>
<tr>
<td>Total lab hours</td>
<td></td>
</tr>
<tr>
<td>Total exercise hours</td>
<td>18</td>
</tr>
<tr>
<td>Attendance</td>
<td>Highly recommended</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
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</table>

### Specific educational objectives

The course aims at providing concepts and skills in the industrial collaborative robotics domain. Students will learn: (i) fundamental concepts and methodologies of industrial Human-Robot Interaction (HRI); (ii) fundamental concepts of safety of machinery and risk assessment for industrial traditional and collaborative robots concepts; (iii) fundamental and advanced concepts of robot kinematics useful in collaborative applications. Then, they will acquire fundamental knowledge and competences on how to program and operate industrial collaborative robots.

### Lecturer

- **Prof. Renato Vidoni**
- **Dr. Luca Gualtieri**

### Scientific sector of the lecturer

- Ing-Ind/13

### Teaching language

- English

### Office hours

- To be agreed upon

### Teaching assistant (if any)

- **Dr. Matteo De Marchi**

### Office hours

- /

### List of topics covered

The lecture hours cover the following main topics:

1. Introduction to industrial collaborative robotics
2. Safety standards and deliverables for (collaborative) robotics
3. Collaborative operations according to ISO TS 15066
4. Mechanical risk assessment for collaborative robotics
systems
5. From manual to collaborative operations
6. Redundant robots: Inverse and differential kinematics, redundancy exploitation in collaborative applications
7. Human and skeleton tracking
8. Examples of applications and implementation of collaborative tasks
9. Robot/Cobot programming (basic and advanced) and motion planning

Exercises:
Hands on exercises
Presentation and evaluation/elaboration of case studies.

Teaching format
Frontal lectures,
Exercises (Case study elaboration)

Learning outcomes (ILOs)
1. Knowledge and understanding
   • The student knows the basics of industrial collaborative robotics.
   • The student knows the safety standards and deliverables related to (collaborative) robotics.
   • The student knows how to treat kinematic redundancy
2. Applying knowledge and understanding
   • The student applies and practices theoretical contents through hands-on exercises and case studies.
   • Theory contents are practiced through practical examples.
3. The student will be able to make judgments selecting:
   • the suitable collaborative robotic system for a practical industrial solution.
4. Communication skills
   • Ability to present the acquired knowledge and competences with a proper language
   • Ability to express concepts with the field related technical terminology.
5. Learning skills
   • Ability to autonomously extend the knowledge acquired during the study course.

Assessment
Formative assessment

<table>
<thead>
<tr>
<th>Form</th>
<th>Length /duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercises in the lecture room</td>
<td>After each lecture unit</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Group work and lab activities</td>
<td>In the exercise hours</td>
<td>1, 2, 3, 5</td>
</tr>
</tbody>
</table>
## Summative assessment

<table>
<thead>
<tr>
<th>Form</th>
<th>%</th>
<th>Length/duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exam with theory questions</td>
<td>50%</td>
<td>1 hour</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Project work</td>
<td>50%</td>
<td>15 min of presentation</td>
<td>2, 3, 4, 5</td>
</tr>
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### Assessment language

English

### Evaluation criteria and criteria for awarding marks

Final evaluation by a single final grade.

The final grade is calculated 50% from the results of the written exam and 50% from the results of the project work performed within the exercises.

Criteria for the evaluation of the written examination: completeness and correctness of the answers.

Criteria for the evaluation of the project work / case study: accuracy and completeness as well as creativity and innovation of the proposed solution and quality of presentation.

### Required readings

Lecture notes and documents for the exercise will be available on the reserve collections

### Supplementary readings

TBA