Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Industrial Collaborative Robotics
Course code	47584
Scientific sector	IIND-05/A (Module 1) "Safety and ergonomics in industrial human-robot interaction" IIND-02/A (Module 2) "Collaborative robotics applications in Industry"
Degree	Master in Industrial Mechanical Engineering
Semester	1 (2)
Year	OPT
Academic year	2024/2025
Credits	6
Modular	Yes

Total lecturing hours	28
Total lab and exercise hours	28
Attendance	Not mandatory
Recommended preliminary knowledge	Minimum programming competences
Connections with other courses	"Mechatronics and robotics" "AI-Applications in Industry"
Course page	https://www.unibz.it/en/faculties/engineering/master-energy-engineering/course-offering/?academicYear=2024

Specific educational objectives	*This elective course is aimed at providing concepts and skills in the industrial collaborative robotics domain. Students will learn fundamental concepts and methodologies for developing and implementing safe collaborative applications as well as they will practice in the Smart Mini Factory lab through hands-on exercises and case-studies.*

Module 1	**Safety and ergonomics in industrial human-robot interaction**
Lecturer	Dr. Luca Gualtieri
Scientific sector of the lecturer	IIND-05/A
Teaching language	English
Office hours	
Teaching assistant *(if any*	
Office hours	Appointment by email
List of topics covered	The lecture hours cover the following main topics:

	• Fundamentals of industrial Human Robot Interaction (iHRI) • Risk assessment for collaborative applications • Safety measures for industrial HRI • Human factors and ergonomics in advanced iHRI • AI-based safety critical systems in iHRI
Professional applications of the covered topics	The topics presented in this course can be applied in all those professional activities involving the design or the re-design of industrial tasks where a collaborative robot can be adopted. Furthermore, professional applications can be found in companies designing, implementing and operating mechanical, mechatronic, automation and manufacturing engineering applications where humans and robots share the workspace.
Teaching format	Frontal lectures and seminars held by guest researchers and experts; exercises/Smart Mini Factory lab activity/case study elaboration.

Module 2	**Collaborative robotics applications in Industry**
Lecturer	TBA and Dr. Rabert Rajesh Mallavarapu
Scientific sector of the lecturer	IIND-02/A
Teaching language	English
Office hours	Appointment by email
Teaching assistant *(if any)*	-
Office hours	-
List of topics covered	The lecture hours cover the following main topics: • Safety standards and their application/implementation. • Sensors for obstacle/human tracking and for validation/certification of industrial collaborative applications. • Human and skeleton tracking. • Redundant robots and redundancy exploitation in collaborative applications. • (Collaborative) Robot programming – basic and advanced - and motion planning. • Examples of applications and implementation of collaborative tasks.
Professional applications of the covered topics	The topics presented in this course can be applied in all those professional activities involving the design or the re-design of industrial tasks where a collaborative robot can be adopted. Furthermore, professional applications can be found in companies designing, implementing and operating mechanical, mechatronic, automation and manufacturing engineering applications where humans and robots share the workspace.
Teaching format	Frontal lectures and seminars held by guest researchers and experts; exercises/Smart Mini Factory lab activity/case study elaboration.

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<td>Learning outcomes</td>
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Intended Learning Outcomes (ILO)

1. <u>Knowledge and understanding</u>

Students should acquire the knowledge and the understanding of:
• Industrial human robot-interaction principles;
• Safety standards and deliverables related to (collaborative) robotics.
• Risk assessment for collaborative applications.
• Human factors and ergonomics in industrial human-robot interaction.
• Programming of industrial collaborative robotic systems.

2. <u>Applying knowledge and understanding</u>

• The student applies and practices theoretical contents through hands-on exercises and case studies.
• Theory contents are practiced through practical examples.

3. <u>Making judgements</u>

• For the selection of suitable collaborative robotic systems and sensors for a practical industrial solution.
• For the conversion of manual tasks in collaborative tasks

4. <u>Communication skills</u>

• Ability to present the acquired knowledge and competences with a proper language.
• Ability to express concepts with the field related technical terminology.

5. <u>Ability to learn</u>

• Ability to autonomously extend the knowledge acquired during the study course
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<td>Assessment</td>
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Formative assessment
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<tr><th>Form</th><th>Length /duration</th><th>ILOs assessed</th></tr>
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	Exercises in the lecture room | After each unit lecture | 1, 2, 3 Group work and lab hands-on activities | During the ex/lab hours | 1, 2, 3, 5 **Summative assessment** **Form** | **%** | **Length /duration** | **ILOs assessed** Written exam with questions on the theory | 50% | 1 hour | 1, 2, 3, 5 Project work | 50% | Case study and subsequent presentation of the work | 2, 3, 4, 5
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. 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 docs for the ex/lab sessions will be made available on the online platforms
Supplementary readings	TBA