Syllabus

Course Description

Course Title	Industrial Collaborative Robotics
Course Code	47584
Course Title Additional	
Scientific-Disciplinary Sector	
Language	English
Degree Course	Master in Industrial Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Luca Gualtieri, Luca.Gualtieri@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38728
Teaching Assistant	
Semester	First semester
Course Year/s	2
CP	6
Teaching Hours	28
Lab Hours	28
Individual Study Hours	80
Planned Office Hours	22
Contents Summary	The course aims at providing concepts and skills in the industrial collaborative robotics domain. Students will learn: (i) fundamental and advanced concepts of industrial Human-Robot Interaction (HRI); (ii) fundamental and advanced concepts of safety of machinery and risk assessment for industrial traditional and collaborative robots; (iii) fundamental concepts of ergonomics in advanced human-robot interaction; (iv) 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.

Course Topics	Main topics for the module "Safety and ergonomics in industrial human-robot interaction": • Fundamentals of industrial Human Robot Interaction (iHRI) • Risk assessment for collaborative applications • Safety measures for industrial HRI • Human factors and ergonomics in advanced iHRI Main topics for the module "Collaborative robotics applications in Industry": • 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.
Keywords	Industrial Human-Robot Interaction Collaborative Robotics Safety of Machinery Human Tracking Motion Planning
Recommended Prerequisites	Minimum programming competences.
Propaedeutic Courses	
Teaching Format	Frontal lectures and seminars held by guest researchers and experts; Exercises/Smart Mini Factory lab activities/case study elaboration.
Mandatory Attendance	Not mandatory
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding Students should acquire the knowledge and the understanding of: Applying knowledge and understanding Making judgements Communication skills

	Ability to learn
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Formative Assessment: • Exercises in the lecture room (After each unit lecture); • Group work and lab hands-on activities (During the ex/lab hours). Summative Assessment: • Written exam with questions on the theory (1h): 50% of final grade; • Project work encompassing case study and subsequent presentation of the work: 50% of final grade.
Evaluation Criteria	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 are: • completeness and correctness of the answers. Criteria for the evaluation of the project work / case study are: • 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 exercises/lab sessions will be made available on the online platforms
Supplementary Readings	
Further Information	
Sustainable Development Goals (SDGs)	Reduced inequalities, Decent work and economic growth

Course Module

Course Constituent Title	Safety and Ergonomics in industrial human-robot interaction

Course Code	47584A
Scientific-Disciplinary Sector	IIND-05/A
Language	English
Lecturers	Prof. Luca Gualtieri, Luca.Gualtieri@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38728
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	16
Lab Hours	12
Individual Study Hours	40
Planned Office Hours	9
Contents Summary	The course aims at providing concepts and skills in the industrial collaborative robotics domain. Students will learn: (i) fundamental and advanced concepts of industrial Human-Robot Interaction (HRI); (ii) fundamental and advanced concepts of safety of machinery and risk assessment for industrial traditional and collaborative robots; (iii) fundamental concepts of ergonomics in advanced human-robot interaction; (iv) 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.
Course Topics	INTRODUCTION TO INDUSTRIAL ADVANCED HRI - Fundamentals of industrial human-robot interaction; - Applications; - Mechanical risk in iHRI; - Technology analisys; - Case studies and examples; SAFETY OF MACHINERY AND RISK ASSESSMENT - Basics of Occupational Health and Safety; - The Machinery Directive and the EHSRs; - Risk assessment for machinery;

	- Safety by design; - Case studies and examples; SAFETY IN INDUSTRIAL HRI - BASICS - Safety of collaborative robotics applications; - Standards and deliverables for safety in iHRI; - Safety modalities in iHRI according to ISO TS 15066; - The new Machinery Regulation; SAFETY IN INDUSTRIAL HRI - ADVANCED - Modeling human-robot contacts; - Power and Force Limiting; - Design of safe end-effectors; - Measures for risk prevention and mitigation in collaborative applications; Laboratory: - Comparing risk assessment for traditional and collaborative robotics application by using the ISO TR 14121 methodology; - Human-robot contact analysis and computation of Power and Force Limiting parameters; - Design of safe collaborative applications;
Teaching Format	Frontal lectures, exercises and case study discussion.
Required Readings	Lecture notes and docs for the ex/lab sessions will be made available on the online platforms
Supplementary Readings	

Course Module

Course Constituent Title	Collaborative Robotics Applications in Industry
Course Code	47584B
Scientific-Disciplinary Sector	IIND-02/A
Language	English
Lecturers	Prof. Renato Vidoni, renato.vidoni@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/31254 Dott. Rabert Rajesh Mallavarapu,

	RabertRajesh.Mallavarapu2@student.unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/48195
Teaching Assistant	
Semester	First semester
CP	3
Responsible Lecturer	
Teaching Hours	12
Lab Hours	16
Individual Study Hours	40
Planned Office Hours	13
Contents Summary	The course aims at providing concepts and skills in the industrial collaborative robotics domain. Students will learn: (i) fundamental and advanced concepts of industrial Human-Robot Interaction (HRI); (ii) fundamental and advanced concepts of safety of machinery and risk assessment for industrial traditional and collaborative robots; (iii) fundamental concepts of ergonomics in advanced human-robot interaction; (iv) 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.
Course Topics	
Teaching Format	Frontal lectures and seminars held by guest researchers and experts; Exercises/Smart Mini Factory lab activities/case study elaboration.
Required Readings	Lecture notes and docs for the ex/lab sessions will be made available on the online platforms
Supplementary Readings	