# Syllabus

## *Kursbeschreibung*

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| **Titel der Lehrveranstaltung** | Industrial Collaborative Robotics |
| **Code der Lehrveranstaltung** | 47584 |
| **Zusätzlicher Titel der Lehrveranstaltung** | |
| **Wissenschaftlich-disziplinärer Bereich** | |
| **Sprache** | Englisch |
| **Studiengang** | Master in Industrie- und Maschineningenieurwesen |
| **Andere Studiengänge (gem. Lehrveranstaltung)** | |
| **Dozenten/Dozentinnen** | Prof. Luca Gualtieri,<br>Luca.Gualtieri@unibz.it<br>https://www.unibz.it/en/faculties/engineering/academic-staff/person/38728 |
| **Wissensch. Mitarbeiter/Mitarbeiterin** | |
| **Semester** | Erstes Semester |
| **Studienjahr/e** | 2 |
| **KP** | 6 |
| **Vorlesungsstunden** | 28 |
| **Laboratoriumsstunden** | 28 |
| **Stunden für individuelles Studium** | 80 |
| **Vorgesehene Sprechzeiten** | 22 |
| **Inhaltsangabe** | The course aims at providing concepts and skills in the industrial collaborative robotics domain.<br>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) |

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| | fundamental and advanced concepts of robot kinematics useful in collaborative applications.<br>Then, they will acquire fundamental knowledge and competences on how to program and operate industrial collaborative robots. |
| **Themen der Lehrveranstaltung** | Main topics for the module "Safety and ergonomics in industrial human-robot interaction":<br>• Fundamentals of industrial Human Robot Interaction (iHRI)<br>• Risk assessment for collaborative applications<br>• Safety measures for industrial HRI<br>• Human factors and ergonomics in advanced iHRI<br><br>Main topics for the module "Collaborative robotics applications in Industry":<br>• Safety standards and their application/implementation.<br>• Sensors for obstacle/human tracking and for validation/certification of industrial collaborative applications.<br>• Human and skeleton tracking.<br>• Redundant robots and redundancy exploitation in collaborative applications.<br>• (Collaborative) Robot programming – basic and advanced - and motion planning.<br>• Examples of applications and implementation of collaborative tasks. |
| **Stichwörter** | Industrial Human-Robot Interaction<br>Collaborative Robotics<br>Safety of Machinery<br>Human Tracking<br>Motion Planning |
| **Empfohlene Voraussetzungen** | Minimum programming competences. |
| **Propädeutische Lehrveranstaltungen** | |
| **Unterrichtsform** | Frontal lectures and seminars held by guest researchers and experts;<br>Exercises/Smart Mini Factory lab activities/case study elaboration. |
| **Anwesenheitspflicht** | Not mandatory |
| **Spezifische Bildungsziele und erwartete** | Knowledge and understanding<br>Students should acquire the knowledge and the understanding of: |

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| **Lernergebnisse** | Applying knowledge and understanding<br><br>Making judgements<br><br>Communication skills<br><br>Ability to learn |
| **Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche Informationen)** | |
| **Art der Prüfung** | Formative Assessment:<br>• Exercises in the lecture room (After each unit lecture);<br>• Group work and lab hands-on activities (During the ex/lab hours).<br><br>Summative Assessment:<br>• Written exam with questions on the theory (1h): 50% of final grade;<br>• Project work encompassing case study and subsequent presentation of the work: 50% of final grade. |
| **Bewertungskriterien** | 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.<br><br>Criteria for the evaluation of the written examination are:<br>• completeness and correctness of the answers.<br><br>Criteria for the evaluation of the project work / case study are:<br>• accuracy and completeness as well as creativity and innovation of the proposed solution and quality of presentation. |
| **Pflichtliteratur** | Lecture notes and docs for the exercises/lab sessions will be made available on the online platforms |
| **Weiterführende Literatur** | |

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| **Weitere Informationen** | |
| **Ziele für nachhaltige Entwicklung (SDGs)** | Weniger Ungleichheiten, Menschenwürdige Arbeit und Wirtschaftswachstum |

# *Kursmodul*

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| **Titel des Bestandteils der Lehrveranstaltung** | Safety and Ergonomics in industrial human-robot interaction |
| **Code der Lehrveranstaltung** | 47584A |
| **Wissenschaftlich-disziplinärer Bereich** | IIND-05/A |
| **Sprache** | Englisch |
| **Dozenten/Dozentinnen** | Prof. Luca Gualtieri,<br>Luca.Gualtieri@unibz.it<br>https://www.unibz.it/en/faculties/engineering/academic-staff/person/38728 |
| **Wissensch. Mitarbeiter/Mitarbeiterin** | |
| **Semester** | Erstes Semester |
| **KP** | 3 |
| **Verantwortliche/r Dozent/in** | |
| **Vorlesungsstunden** | 16 |
| **Laboratoriumsstunden** | 12 |
| **Stunden für individuelles Studium** | 40 |
| **Vorgesehene Sprechzeiten** | 9 |
| **Inhaltsangabe** | The course aims at providing concepts and skills in the industrial collaborative robotics domain.<br>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.<br>Then, they will acquire fundamental knowledge and competences on how to program and operate industrial collaborative robots. |

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| **Themen der Lehrveranstaltung** | INTRODUCTION TO INDUSTRIAL ADVANCED HRI<br>- Fundamentals of industrial human-robot interaction;<br>- Applications;<br>- Mechanical risk in iHRI;<br>- Technology analisys;<br>- Case studies and examples;<br><br>SAFETY OF MACHINERY AND RISK ASSESSMENT<br>- Basics of Occupational Health and Safety;<br>- The Machinery Directive and the EHSRs;<br>- Risk assessment for machinery;<br>- Safety by design;<br>- Case studies and examples;<br><br>SAFETY IN INDUSTRIAL HRI - BASICS<br>- Safety of collaborative robotics applications;<br>- Standards and deliverables for safety in iHRI;<br>- Safety modalities in iHRI according to ISO TS 15066;<br>- The new Machinery Regulation;<br><br>SAFETY IN INDUSTRIAL HRI - ADVANCED<br>- Modeling human-robot contacts;<br>- Power and Force Limiting;<br>- Design of safe end-effectors;<br>- Measures for risk prevention and mitigation in collaborative applications;<br><br>Laboratory:<br>- Comparing risk assessment for traditional and collaborative robotics application by using the ISO TR 14121 methodology;<br>- Human-robot contact analysis and computation of Power and Force Limiting parameters;<br>- Design of safe collaborative applications; |
| **Unterrichtsform** | Frontal lectures, exercises and case study discussion. |
| **Pflichtliteratur** | Lecture notes and docs for the ex/lab sessions will be made available on the online platforms |
| **Weiterführende Literatur** | |

# *Kursmodul*

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| **Titel des Bestandteils der Lehrveranstaltung** | Collaborative Robotics Applications in Industry |
| **Code der Lehrveranstaltung** | 47584B |
| **Wissenschaftlich-disziplinärer Bereich** | IIND-02/A |
| **Sprache** | Englisch |
| **Dozenten/Dozentinnen** | Prof. Renato Vidoni,<br>renato.vidoni@unibz.it<br>https://www.unibz.it/en/faculties/engineering/academic-staff/person/31254<br>Dott. Rabert Rajesh Mallavarapu,<br>RabertRajesh.Mallavarapu2@student.unibz.it<br>https://www.unibz.it/en/faculties/engineering/academic-staff/person/48195 |
| **Wissensch. Mitarbeiter/Mitarbeiterin** | |
| **Semester** | Erstes Semester |
| **KP** | 3 |
| **Verantwortliche/r Dozent/in** | |
| **Vorlesungsstunden** | 12 |
| **Laboratoriumsstunden** | 16 |
| **Stunden für individuelles Studium** | 40 |
| **Vorgesehene Sprechzeiten** | 13 |
| **Inhaltsangabe** | The course aims at providing concepts and skills in the industrial collaborative robotics domain.<br>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.<br>Then, they will acquire fundamental knowledge and competences |

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| | on how to program and operate industrial collaborative robots. |
| **Themen der Lehrveranstaltung** | |
| **Unterrichtsform** | Frontal lectures and seminars held by guest researchers and experts; Exercises/Smart Mini Factory lab activities/case study elaboration. |
| **Pflichtliteratur** | Lecture notes and docs for the ex/lab sessions will be made available on the online platforms |
| **Weiterführende Literatur** | |