Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Industrial Automation and Mechatronics
Course code	47542
Scientific sector	ING-IND/13 ING-IND/32
Degree	**Master in Industrial Mechanical Engineering**
Semester	II
Year	I
Academic year	2019/20
Credits	10 (5+5)
Modular	Yes

Total lecturing hours	28 + 28
Total lab hours	
Total exercise hours	18+18
Attendance	
Prerequisites	Suggested: Mechanics of Machinery; Electrotechnics; Electrical Machines
Course page	

Specific educational objectives	The course is aimed at providing concepts and skills in the industrial automation domain related to mechatronics, robotics, electrical machines and drives. Students will learn, in the first module, fundamental concepts and methodologies for understanding and modelling mechatronic systems and industrial robots; then, they will acquire fundamental knowledge and competences on how to simulate and program industrial robots. In the second module the course discusses the theoretical basis and the practical applications of the electrical drives technology applied to automation and mechatronic systems. At first, the theory of electrical motors (actuators) is introduced. Then, the drive system is analysed considering all of its components and the various control strategies that can be adopted. Emphasis is given to practical applications, especially considering the advantages achievable with the latest technologies.

Module 1	Mechatronics and Robotics
Lecturer	prof Renato Vidoni, K0.06 renato.vidoni@unibz.it
Scientific sector of the lecturer	ING-IND/13
Teaching language	English
Office hours	By appointment

Teaching assistant (if any)	NN
Office hours	Tdb
List of topics covered	The module will cover: • an introduction to mechatronics and robotic systems; • an overview of industrial, mobile and service robots • Robotics: 3D Kinematics and statics - Direct and inverse kinematics. - Application to industrial manipulators (PUMA, SCARA). - Differential Kinematics and Statics. • Sensors and actuators for industrial robots and mechatronic systems. • Basis on simulation and programming of robotic systems.
Teaching format	The topics are presented by the professor by means of Power Point presentations or the blackboard. Practical parts and lab activities/exercises are planned also in the SMT-Smart Mini Factory learning factory laboratory. A selection of the material presented in class as well as online resources and useful material will be available in the course reserve collection database. Further deepening material will be supplied or recommended by the teacher.

Module 2	Electric Drives and Machines
Lecturer	
Scientific sector of the lecturer	ING-IND/32
Teaching language	English
Office hours	By appointment
Teaching assistant (if any)	-
Office hours	-
List of topics covered	The course covers the following topics: • Rotating electrical machines, operating principles, main terminology and industrial standards • Static conversion of electrical energy: three-phase inverter and current control. • DC motor: principle of operation, main characteristics and construction, electrical drives with DC motor, sizing of a real application example. • Synchronous motor (“brushless”): principle of operation, main characteristics and construction, electrical drives with synchronous motor • Asynchronous motor: principle of operation, main characteristics and construction, electrical drives with asynchronous motor • Stepper motors
Teaching format	Frontal lectures by means of Power Point presentations or

	on the blackboard, exercises and case studies, computer laboratory, excursions.

Learning outcomes	1) Knowledge and understanding The students will know the most important concepts about: Module I • mechatronic and robotic fundamentals (definitions, components and elements) • the principles of simulating and programming an industrial robotic systems • 3D mechanisms from a kinematic point of view Module II • electrical machines operating principle and characteristics • electrical drive systems for automation and mechatronic applications • the operating principles and design criteria for the most common drive systems, considering in particular the state-of-the-art in industry. 2) Applying knowledge and understanding Module I The students will know how to treat a robotic system form a kinematic and static point of view as well as how to set-up a simple robotic simulator and control program. Module II The students will be able to verify the requirements of an electric drive and to understand the real-world operation of basic control methods for electric drives. 3) The student will be able to make judgments selecting: • the suitable robotic system for a practical industrial solution • the more adequate electrical drive system for a particular application. 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** In class and laboratory exercises and activities (2,3,4,5) **Summative assessment** The assessment of the course is:

	• Written and oral exam. Written exam with exercises and questions to test the ability to use and transfer the acquired knowledge as well as to make judgement and use a proper technical language (1,2,3,4). Oral exam with review questions on the course topics and, possibly, on the lab-exercises activities (1-5).
Assessment language	English
Evaluation criteria and criteria for awarding marks	The final mark will be obtained combining the evaluations of the final written test and of the oral examination. Relevant for assessment : clarity of answers, mastery of language (also with respect to teaching language), ability to summarize, evaluate, and establish relationships between topics, skills in critical thinking, ability to summarize and make judgments.

Required readings	Lecture notes and documents for exercise will be available on the reserve collections There is no single textbook that covers the entire course. The course material is collected from various sources that will be announced during the course. A selection of the material presented in class and useful material will be available in the course reserve collection database
Supplementary readings	Module 1: Siciliano, B., Sciavicco, L., Villani, L., Oriolo, G., Robotics, Modelling, Planning and Control, Springer J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education International Module 2: W. Leonhard, Control of Electrical Drives, Springer, ISBN 3-540-41820-2 I. Boldea, S.A. Nasar, Electric Drives, CRC Press, 1998 G.R. Slemon, Electric machines and drives, Addison-Wesley, MA, ISBN 0-201-57885-9, 1992 S. Bolognani, M. Zigliotto, Azionamenti Elettrici, Libreria Progetto, Padova, 1998