Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Industrial Automation and Mechatronics
Course code	
Scientific sector	ING-IND/13 , ING-IND/32
Degree	**Master in Industrial Mechanical Engineering**
Semester	II
Year	I
Academic year	2017/18
Credits	10 (5+5)
Modular	Yes

Total lecturing hours	28+28
Total lab hours	
Total exercise hours	16+16
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
Teaching language	English
Office hours	By appointment
Teaching assistant *(if any)*	Giovanni Carabin
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.* *A selection of the material presented in class and useful material will be available in the course reserve collection database before the lessons.* *Further deepening material will be supplied or recommended by the teacher.*

Module 2	Electrical drives
Lecturer	Dr. Sandro Calligaro, K3.05 Sandro.Calligaro@unibz.it
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 real application examples. • 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	At the end of the course the student will have <u>knowledge and understanding</u> to master the most important concepts about: • *mechatronic and robotic fundamentals* • *the main components and elements of a mechatronic and robotic system* • *the principles of simulating and programming an industrial robotic systems* • *3D mechanisms from a kinematic point of view* • *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.* The student will be able to <u>make judgments</u> selecting: • *the suitable robotic system for a practical industrial solution* • *the more adequate electrical drive system for a particular application.* *Communication skills:* • *Ability to present the acquired knowledge and competences with a proper language* • *Ability to express concepts with the field related technical terminology.* *Learning skills* • *Ability to autonomously extend the knowledge acquired during the study course.*
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.* *Oral exam with review questions on the course topics and, possibly, on the lab-exercises activities.*
Assessment language	English
Evaluation criteria and criteria for awarding marks	*Final mark* *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	*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