Syllabus

Course Description

Course Title	Functional Mechanical Design
Course Code	47563
Course Title Additional	
Scientific-Disciplinary Sector	ING-IND/13
Language	English
Degree Course	Master in Industrial Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Dott. Roberto Belotti, Roberto.Belotti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38331
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	5
Teaching Hours	28
Lab Hours	18
Individual Study Hours	79
Planned Office Hours	
Contents Summary	The course aims at giving the guidelines for the functional design of automatic machines, in particular taking into account mechanical efficiency. Criteria and methods to analyze and choose mechanical devices, design motion laws and to evaluate the best system to minimize the energy dissipation in electromechanical systems will be addressed.
Course Topics	• Introduction to functional design, classification of the mechanisms and motion systems. • Basic concepts and definitions. Mechanical efficiency, performance, energy efficiency and energy savings in automatic

	machines. Direct/reverse energy flow and motor–load systems. • Mechanical components for transferring and transforming energy. Classification based on function, working principle as well as performance and efficiency. • Optimization aimed at improving the quality of motion and efficiency. • Energy storage systems and energy recovery. Classification (working principle and scope of use). • Classification of motion laws implemented in automatic machines. Analysis of the main requirements in the design of a motion law and its optimization.
Keywords	machine dynamics, mechanical transmission, efficiency, trajectory planning, electric motor
Recommended Prerequisites	None.
Propaedeutic Courses	
Teaching Format	Frontal lectures, hand-calculation exercises, computer-assisted exercises.
Mandatory Attendance	Strongly recommended.
Specific Educational Objectives and Learning Outcomes	1. Knowledge and Understanding: • Understand the kinematic and dynamic properties of mechanism for the transmission of motion; • Understand the properties of the most common trajectories and their influence on the machine dynamics 2. Applying knowledge and understanding: • Evaluate and select the proper transmission system considering mechanical and energy efficiency; • Identify the main components of transmission systems and sources of inefficiency 3. Making judgments: • Select and design an effective motion law under different working conditions and targets; • Choose suitable combination of mechanical and electric components for energy transformation and transfer 4. Communication skills: • Ability to structure and prepare scientific and technical

	documentation 5. Learning skills: • Ability to independently build upon the knowledge acquired during the study course by reading and understanding scientific and technical documentation.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	- Formative assessment: In-class exercises: continuosly in exercise courses; Learning outcomes assessed: 1, 2, 3, 4, 5; - Summative assessment: Written exam: 3 hours; Learning outcomes assessed: 1, 2, 3, 4, 5.
Evaluation Criteria	The written examination will include both theoretical questions and numerical exercises to show ability to solve problems handled in this course. Written examination: Theoretical knowledge (35%) Correctness of methods (30%) Correctness in solution (30%) Appropriate use of units (5%).
Required Readings	Slides provided to the students after each lecture and notes taken by students during lecture.
Supplementary Readings	A collection of suggested readings from various sources will be announced during the course. Such sources will be papers, manuals, technical notes, and excerpts from textbooks, including • Biagiotti, Luigi, and Claudio Melchiorri. *Trajectory planning for automatic machines and robots*. Springer Science & Business Media, 2008. • Norton, Robert L. *Kinematics and dynamics of machinery*. McGraw Hill Higher Education, 2009. • Filizadeh, S. *Electric Machines and Drives: Principles, control, modelling and simulation*. CRC Press, 2013.
Further Information	
Sustainable Development Goals (SDGs)	Affordable and clean energy, Climate action, Responsible consumption and production