Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Functional Mechanical Design for Energy Efficiency
Course code	47509 / 47563 Functional Mechanical Design
Scientific sector	ING-IND/13
Degree	Master Industrial Mechanical Engineering
Semester	I (winter semester)
Year	II (second year of master)
Academic year	2021-2022
Credits	5
Modular	No

Total lecturing hours	28
Total lab hours	0
Total exercise hours	18
Attendance	Strongly recommended
Prerequisites	None, though some knowledge of electrical machines will be of assistance. E.g. the content of the course "Electric Power Conversion Equipment" (LM-30)
Course page	See course team in MS Teams

Specific objectives	The course aims at giving the guidelines for the functional design of automatic machines, in particular taking into account mechanical and energetic efficiency. Criteria and methods to analyze and choose mechanical devices, design motion laws and to evaluate the best system to minimize the energy consumption in electromechanical systems will be addressed.

Lecturer	Dr. Roberto Belotti / Dr. Erich Wehrle
Scientific sector of the lecturer	ING-IND/13
Teaching language	English
Office hours	See timetable online: www.unibz.it/en/timetable/ and by appointment
Teaching assistant *(if any)*	N.A.
Office hours of teaching assistant	N.A.
List of topics covered	• Introduction: 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. Retrograde

	motion 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.
Teaching format	Frontal lectures, hand-calculation exercises, computer exercises, project

Learning outcomes	**1. Knowledge and Understanding** • Identify the main components of transmission systems and sources of inefficiency • Understand the basic principles of energy storage, recovery and redistribution systems; **2. Applying knowledge and understanding** • Evaluate and select the proper transmission system considering mechanical and energy efficiency; **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.
Assessment	**Formative assessment** **Form** | **Details** | **Learning outcomes assessed** In-class exercises | Continuously in exercise courses | 1, 2, 3, 4, 5 **Summative assessment**

	Form	Part	Details	Learning outcomes assessed
	Written exam	2/3	2 h	1, 2, 3, 4, 5
	Project	1/3	Practical project culminating in a written report (ca. 5–15 pages) and an oral presentation (ca. 15 min)	1, 2, 3, 4, 5, 6

Assessment language	English
Evaluation criteria and criteria for awarding marks	The final grade is the written exam grade The written examination will include analytical and numerical examples to show ability to solve problems handled in this course. The project is carried out in groups of one or two students, although groups of three or individual projects will be considered after approval from the lecturer. You must achieve a passing grade for the written exam to pass the course.

Form	Evaluation criteria and weight
Written examination (2/3)	Theoretical knowledge (35%) Correctness of methods (30%) Correctness in solution (30%) Appropriate use of units (5%)
Project (1/3)	Understanding of project goals (10% Correctness of methods (30%) Correctness in results (30%) Communication of results (30%)

Required readings	Slides provided to the students after each lecture and notes taken by students during lecture
Supplementary readings	There is no single textbook that covers the entire course. A collection of suggested readings from various sources will be announced during the course.