Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Functional Mechanical Design
Course code	47563
Scientific sector	ING-IND/13
Degree	Master Industrial Mechanical Engineering
Semester	1
Year	1
Academic year	2025-2026
Credits	5
Modular	No

Total lecturing hours	28
Total lab hours	0
Total exercise hours	18
Attendance	Strongly recommended
Prerequisites	None.
Course page	https://www.unibz.it/en/faculties/engineering/master-industrial-mechanical-engineering/course-offering/?academicYear=2025

Specific objectives	The course aims to give 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 evaluate the best system to minimize energy dissipation in electromechanical systems will be addressed.

Lecturer	Dr. Roberto Belotti
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 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. • 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-assisted exercises

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.
Assessment	**Formative assessment**

Form	Details	Learning outcomes assessed
In-class exercises	Continuously in exercise courses	1, 2, 3, 4, 5

<table>
<tr><td></td><td>Summative assessment
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<tr><th>Form</th><th>Duration</th><th>Learning outcomes assessed</th></tr>
<tr><td>Written exam</td><td>3 h</td><td>1, 2, 3, 4, 5</td></tr>
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<tr><td>Assessment language</td><td>English</td></tr>
<tr><td>Evaluation criteria and criteria for awarding marks</td><td>The written examination will include both theoretical questions and numerical exercises to show the ability to solve problems handled in this course.
<table>
<tr><th>Form</th><th>Evaluation criteria and weight</th></tr>
<tr><td>Written examination</td><td>Theoretical knowledge (35%)
Correctness of methods (30%)
Correctness in solution (30%)
Appropriate use of units (5%)</td></tr>
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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.