# Syllabus

## Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>Applied Mechanics and Technologies for Energy Efficiency</th>
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<tbody>
<tr>
<td>Course code</td>
<td>47509</td>
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<tr>
<td>Scientific sector</td>
<td>Ing-Ind/13</td>
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<tr>
<td>Degree</td>
<td>Master in Industrial and Mechanical Engineering LM-33</td>
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<tr>
<td>Semester</td>
<td>1</td>
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<tr>
<td>Year</td>
<td>1</td>
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<tr>
<td>Academic year</td>
<td>2017/2018</td>
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<tr>
<td>Credits</td>
<td>5</td>
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<tr>
<td>Modular</td>
<td>Yes</td>
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<tr>
<td>Total lecturing hours</td>
<td>28</td>
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<tr>
<td>Total lab hours</td>
<td></td>
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<tr>
<td>Total exercise hours</td>
<td>18</td>
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### Attendance

**Prerequisites**: students should be familiar with the basic knowledges of solid mechanics and mathematical analysis.

**Course page**: [https://www.unibz.it/en/faculties/sciencetechnology/master-industrial-mechanical-engineering/](https://www.unibz.it/en/faculties/sciencetechnology/master-industrial-mechanical-engineering/)

### Specific educational 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

**Roberto Belotti**

### Scientific sector of the lecturer

**ING-IND/13**

### Teaching language

**English**

### Office hours

By appointment

### Teaching assistant (if any)

**Davide D'Amico**

### Office hours

List of topics covered

- Introduction: The functional design. 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.
- Energy storage systems and energy recovery. Classification (working principle and scope of use).
- Mechanical components for transfer and
transformation of energy. Classification based on function, working principle and performance/efficiency.
- Transmissions, articulated mechanisms and mechanisms for machine tools and assembly lines.
- Transmissions, gears and brakes for renewable energy systems (e.g. wind).
- Optimization aimed at improving the quality of motion and efficiency.
- Motion planning and optimization. Classification and choice.
- Motion laws implemented in automatic machines: analysis of the main requirements in the design of a motion law (e.g. acceleration, velocity, vibration, torque limits) and optimization (e.g. modified laws, polynomial, minimum time, jerk, energy).
- Motion planning and optimization for renewable energy systems (e.g. tracking, guidance, active and passive systems).

### Teaching format
Frontal lectures, exercises, labs

### Learning outcomes

**Knowledge and Understanding**
- Identify the main components and sources of inefficiency in motor-transmission-load systems
- Understand the basic principles of the main energy storage, recovery and redistribution systems;

**Applying knowledge and understanding**
- Evaluate and select, from the mechanical and energy efficiency point of view, the proper transmission system;

**Making judgments**
- Select and design an effective motion law under different working conditions and targets;
- Choose suitable and proper mechanical components for energy transformation and transfer

**Communication skills**
- Ability to structure and prepare scientific and technical documentation

**Learning skills**
- Ability to autonomously extend the knowledge acquired during the study course by reading and understanding scientific and technical documentation.

### Assessment
Written exam and written project work

### Assessment language
English

### Evaluation criteria and criteria for awarding marks
The final grade is the written exam grade, augmented or diminished by at most 3 points, according to the project work evaluation. N.B. The written exam grade must be \( \geq 18 \) anyway.

### Required readings
Lecture/Course notes

### Supplementary readings