# Syllabus

## Course description

<table>
<thead>
<tr>
<th><strong>Course title</strong></th>
<th>Applied Mechanics and Technologies for Energy Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course code</strong></td>
<td>45531</td>
</tr>
<tr>
<td><strong>Scientific sector</strong></td>
<td>ING-IND/16 and ING-IND/13</td>
</tr>
<tr>
<td><strong>Degree</strong></td>
<td>Master Energy Engineering</td>
</tr>
<tr>
<td><strong>Semester</strong></td>
<td>I</td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Academic year</strong></td>
<td>2021-2022</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td>12</td>
</tr>
<tr>
<td><strong>Modular</strong></td>
<td>Yes</td>
</tr>
</tbody>
</table>

| **Total lecturing hours** | 36 + 36                                                  |
| **Total lab hours**       | 0                                                        |
| **Total exercise hours**  | 24 +24                                                   |
| **Attendance**            | Strongly recommended                                    |
| **Prerequisites**         | Module 1: students should be familiar with the basic knowledge of mathematical analysis. Some knowledge of electrical machines is preferred, e.g. the content of the course “Electric Power Conversion Equipment” |
| **Course page**           | [https://www.unibz.it/en/faculties/scientechtechnology/master-energy-engineering/](https://www.unibz.it/en/faculties/scientechtechnology/master-energy-engineering/) |

## Module 1

### Technologies and Production Processes for Energy Engineering

<table>
<thead>
<tr>
<th><strong>Lecturer</strong></th>
<th>Dr. Pasquale Russo Spena</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Faculty of Science and Technology</strong></td>
<td></td>
</tr>
<tr>
<td><strong>mail</strong></td>
<td><a href="mailto:pasquale.russospena@unibz.it">pasquale.russospena@unibz.it</a></td>
</tr>
</tbody>
</table>

| **Scientific sector of the lecturer** | Ing-Ind/16 Manufacturing Technology and Systems |
| **Teaching language**              | English                                      |
| **Office hours**                   | By appointment                              |

### Teaching assistant (if any)

| **Office hours** | 18 |

| **List of topics covered** | Basic knowledge about the main features of power generation, storage, and distribution plants. Examination of the production processes (both conventional and advanced) used to yield components and assemblies in the energy engineering field, including: a) gas power generation plants; b) solar power plants; c) eolic plants; |

1/6
d) tanks and pressure containers for energy storage;
e) tube and piping for energy distribution;
f) electric energy distribution.

**Teaching format**
The course is based on hours of frontal lectures and hours dedicated to classroom and/or laboratory activities.
The topics of the course are reported in the lecture notes provided by the professor, as well as in the textbooks of the bibliography. After each lecture, the corresponding pdf presentation will be posted in the Reserve Collection database.
The professor can also provide additional material (e.g., research papers).
The professor can be contacted by students for questions and clarifications by appointment.

**Learning outcomes**

**Knowledge and understanding:**
Students will
1. acquire a knowledge about some important production processes used for the fabrication of the main mechanical assemblies and components in the energy industry;
2. be able to identify the advantages and limitations of these industrial production processes;
3. acquire a basic knowledge of a production process

**Applying Knowledge and understanding:**
4. Students will be able to select some manufacturing processes to be used in the energy industry.
5. Students will have the ability to apply their knowledge to identify which are the main systems and issues of a production process.
6. The exercises in the classroom, progress tests, conversations with the teacher, and the performance of specific tasks would allow to assess and evaluate the students ability to apply his knowledge and understanding of the topics covered during the course.

**Making judgments:**
Students will acquire an autonomy of judgment that will allow him
7. to select proper manufacturing processes for the fabrication of some mechanical assemblies and components in the energy engineering field;
8. to examine objectively the results obtained from analytical processing, numerical simulations or experimental laboratory tests;
9. to make use of technical and scientific literature.

**Communication skills:**
10. Students will have the ability to structure and prepare scientific and technical documentations inherent to the selection of some manufacturing processes used in the
11. students will have the ability to present, communicate, discuss and argue the topics covered in the course.

**Learning skills:**
12. The students will develop learning skills through the individual study of the topics dealt in the lecturing and exercise hours. In addition, the analysis of different problems relative to the fabrication of mechanical components for the energy engineering field will also be addressed by group discussions.
13. The students will have the opportunity to extend the knowledge of the topics of the course by consulting scientific literature, specialized texts, technical standards and international standards that the professor will provide during the course.

### Assessment

#### Formative assessment
In class discussion about the topics covered during the course (ILOS assessed 1,2,3,6,12).

#### Summative assessment
The assessment of the course is:
- Oral exam (ILOS assessed 4,5,7,8,11)

The oral exam consists in 2 or 3 open-end questions to assess the knowledge and understanding of the topics of the course and the ability of the student to present, communicate, discuss and argue the basics of industrial plant systems and of some industrial processes used in energy industry.

Moreover, the student will should reflect on the characteristics of a production process and its limitations in terms of product quality, cost and so forth.

### Assessment language
English

### Evaluation criteria and criteria for awarding marks
The evaluation criterion of the oral exam is based on the knowledge of the topics of the course, the clarity of the response and the properties of language of the student (in relation to the language of the course), the pertinence and the relevance of the response, and the autonomy of judgment.

**Final Mark of the Course “Applied Mechanics and Technologies for energy Efficiency”**
Mathematical average of the marks obtained in the Module 1 and 2.

### Required 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.
Supplementary readings
Additional textbooks, lecture notes, research papers and readings may be provided by the professor.

Module title | Functional Mechanical Design for Energy Efficiency
Module code | 45531B
Scientific sector | ING-IND/13
Degree | Master Energy Engineering
Semester | I (winter semester)
Year | II (second year of master)
Academic year | 2020-2021
Credits | 6

Total lecturing hours | 36
Total lab hours | 0
Total exercise hours | 24
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.-Ing. 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.

<table>
<thead>
<tr>
<th>Teaching format</th>
<th>Frontal lectures, hand-calculation exercises, computer exercises, project</th>
</tr>
</thead>
</table>

### 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.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Formative assessment</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Form</td>
<td>Details</td>
</tr>
<tr>
<td></td>
<td>In-class exercises</td>
<td>Continuously in exercise courses</td>
</tr>
</tbody>
</table>

### Assessment

**Formative assessment**

- In-class exercises: Continuously in exercise courses
  - Learning outcomes assessed: 1, 2, 3, 4, 5
<table>
<thead>
<tr>
<th>Form</th>
<th>Part</th>
<th>Details</th>
<th>Learning outcomes assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exam</td>
<td>2/3</td>
<td>2 h</td>
<td>1, 2, 3, 4, 5</td>
</tr>
<tr>
<td>Project</td>
<td>1/3</td>
<td>Practical project culminating in a written report (ca. 5–15 pages) and an oral presentation (ca. 15 min)</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
</tbody>
</table>

**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.

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

**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.