Syllabus
Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>Engineering Energetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course code</td>
<td>42182</td>
</tr>
<tr>
<td>Scientific sector</td>
<td>ING-IND/10</td>
</tr>
<tr>
<td>Degree</td>
<td>Industrial and Mechanical Engineering</td>
</tr>
<tr>
<td>Semester</td>
<td>II</td>
</tr>
<tr>
<td>Year</td>
<td>III</td>
</tr>
<tr>
<td>Academic year</td>
<td>2022/23</td>
</tr>
<tr>
<td>Credits</td>
<td>8</td>
</tr>
<tr>
<td>Modular</td>
<td>No</td>
</tr>
</tbody>
</table>

| Total lecturing hours | 50                                             |
| Total lab hours       | -                                             |
| Total exercise hours  | 30                                            |
| Attendance            | Strongly recommended                           |
| Prerequisites         | Technical Physics                              |
| Course page           | Insegnamenti offerti / Libera Università di Bolzano (unibz.it) |

Specific educational objectives
The present course is a core teaching in the context of the Bachelor in Industrial and Mechanical Engineering (curriculum Energetics), in the specific area of Energy and Mechanical Engineering (Area delle Attività Formative Caratterizzanti, Thermal Engineering and Industrial Energy Systems, ING-IND/10).

It specifically deals with the fundamental concepts of energetics, integrates and complements topics of thermodynamics and heat transfer introduced in previous elective courses and supplies some tools useful for energy auditing and for the design of energy systems.

The course consists of 48 hours of frontal lectures and 32 hours of exercises.

The lectures introduce the fundamentals of Energetics, by presenting and discussing main issues on the energy resources. Proper terms and definitions will be introduced. Comparative analysis of alternatives paths of energy generation and recovery will be presented.

Exergy concept and fundamentals will be also discussed in order to assess irreversibility losses in energy systems and provide an efficient tool for exergy efficiency assessment of plants.

Thermodynamics of inverse cycles will be recalled with an in-depth presentation of refrigeration machines, heat...
pumps and their working fluids. Both vapor-compression and absorption technologies will be presented.

The knowledge on thermodynamics of gas mixture and psychrometry - already acquired by the students in previous elective courses - will be supplemented with advanced concepts in order to describe and discuss air conditioning cycles.

Compressed air generation and distribution systems will be also presented. The layout of compressed air systems will be discussed along with the characteristics and energy performance of their components.

Exercises proposed during the course consist in solving practical design problems with the aim of giving the students a deeper comprehension and understanding of the topics.

Lecturer
Francesco Patuzzi, francesco.patuzzi@unibz.it, 0471-017609
Vittoria Benedetti, vittoria.benedetti@unibz.it, 0471-017706

Scientific sector of the lecturer
ING-IND/10

Teaching language
English

Office hours
Mondays to Thursday, by appointment

Teaching assistant (if any)
-

Office hours
-

List of topics covered
The course will cover the following topics:

- Energy resources and final uses. Energy vectors and users of an energy system. Comparative analysis of alternatives paths of energy generation and recovery.
- Compressed air generation and distribution systems. Layout of plants and characteristics of components.

Teaching format
The course consists of lectures in which the topics are presented by the professor. There are also classes (exercises) that will give practical examples of the application of the theoretical topics. Course topics will be
presented at the blackboard and using electronic slides. Teaching material and additional materials will be provided by the Professor during the semester.

### Learning outcomes (ILOs)

The learning outcomes need to refer to the Dublin Descriptors:

**Knowledge and understanding**

1. Knowledge and understanding of the fundamentals of energetics, the working principles and technical solutions regarding some significant energy engineering systems

**Applying knowledge and understanding**

2. Applying knowledge and understanding to the solution of energy balances and for problem solving and design of significant engineering systems.

**Making judgements**

3. Ability to make autonomous judgements in the assessment of suitable energy scenarios, in particular regarding energy plants design and operation

**Communication skills**

4. Communication skills to correctly and properly present the concepts acquired in the course and to solve simple numerical application regarding energy systems

**Ability to learn**

5. Lifelong learning skills through the possession of the tools for the acquisition of technical information on the energy generation plants and to update knowledge.

### Formative assessment

<table>
<thead>
<tr>
<th>Form</th>
<th>Length /duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>In class exercises and discussion</td>
<td>32 hours (average duration 30-45 minutes/exercise)</td>
<td>1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>
Summative assessment

Examination of the course is carried out by means of an oral exam. The oral examination includes questions to assess the knowledge and understanding of the course topics and questions designed to assess the ability to transfer these skills to case studies and practical applications.

Questions on practical applications also assess the ability of the student to apply the knowledge and understanding of the course topics, the ability to make judgments and finally, the student communication skills.

<table>
<thead>
<tr>
<th>Form</th>
<th>%</th>
<th>Length /duration</th>
<th>ILOs assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written exam – exercises</td>
<td>33%</td>
<td>60 minutes</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Oral exam – theory</td>
<td>67%</td>
<td>30 minutes</td>
<td>1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>

Assessment language   English

Evaluation criteria and criteria for awarding marks

Students regularly enrolled at the 3rd year of the Bachelor of Industrial and Mechanical Engineering (curriculum in Energetics) are eligible for the attendance of the lessons and the exam. Other exceptional cases have to be discussed with the Professors.

The student is asked to attend a written and an oral exam.

It is relevant for the oral exam to: master the specific language (also with respect to teaching language); prove the understanding of the topics and learning skills; evaluate and establish relationships between topics; grow specific skills in critical thinking.

Regarding the practical applications, it is relevant to clearly describe suitable technical solutions and be able to make critical judgments and apply the theoretical concepts.

The exam mark will be assessed as follows: 33% written exam, 67% oral exam.

Required readings

- Didactic materials will be provided by the professor during the course.
| **Supplementary readings** | - K. Wark, Applied Thermodynamics for Engineers, McGraw-Hill  