# Syllabus

## Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>FLUID MACHINES ENGINEERING</th>
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<tbody>
<tr>
<td>Course code</td>
<td>45527</td>
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<tr>
<td>Scientific sector</td>
<td>Fluid Machinery and energy systems</td>
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<tr>
<td>Degree</td>
<td>Master Energy Engineering</td>
</tr>
<tr>
<td>Semester</td>
<td>2</td>
</tr>
<tr>
<td>Year</td>
<td>1</td>
</tr>
<tr>
<td>Academic year</td>
<td>2020/2021</td>
</tr>
<tr>
<td>Credits</td>
<td>9</td>
</tr>
<tr>
<td>Modular</td>
<td>No</td>
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| Total lecturing hours | 70                          |
| Total lab hours       | 10                          |
| Total exercise hours  | 10                          |
| Attendance            | Recommended                 |
| Prerequisites         | Fluid Machines, Thermodynamics, Mechanics |

### Specific educational objectives

To master the most important concepts about fluid machines dedicated to energy conversion systems and their integration in the energetic system, to give decision tools and criteria for design, cost analysis, efficiency analysis and selection with emphasis to community and small scale plants.

<table>
<thead>
<tr>
<th>Lecturer</th>
<th>Casari Nicola / Briola Stefano</th>
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<tbody>
<tr>
<td>Scientific sector of the lecturer</td>
<td>ING/IND-08</td>
</tr>
<tr>
<td>Teaching language</td>
<td>English</td>
</tr>
<tr>
<td>Office hours</td>
<td></td>
</tr>
<tr>
<td>Teaching assistant (if any)</td>
<td>-</td>
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<tr>
<td>Office hours</td>
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### List of topics covered

The course will cover the following topics:
1. Introduction
   a. Essentials of fluid Machines and Energy systems
      i. Elements of fluid dynamics
      ii. Elements of Fluid Machinery
iii. Elements of Energy systems

b. Introduction to renewable energy

2. Fluid machines for renewable energy

a. Solar Power
   i. Solar Resource
   ii. Solar photovoltaic
   iii. Concentrated and thermodynamic solar
   iv. Utility and community scale

b. Hydro Power
   i. Hydro Resource
   ii. Mini-hydro
   iii. Reversible turbines, PATs and variable speed hydro-turbines
   iv. Utility and community scale
   v. Diagnostics and fault detection

c. Wind Power
   i. Wind resource and Terrain
   ii. Horizontal and vertical axis wind turbines
   iii. Utility and community scale
   iv. Diagnostics and fault detection

d. Waste Heat and Water
   i. Waste Heat
   ii. Waste Water

e. Storages
   i. Types of storage
   ii. P2X
   iii. Hydrogen Applications
   iv. Utility and community scale

f. Grid Management & Economics
   i. Smart Grids
For each of the technologies presented in the course, the tools needed for the performance evaluation (power, work, efficiency, ...) will be defined. For some of the proposed technologies, a techno-economic analysis will be carried out as well.

## Learning outcomes

During the course, the student will gain knowledge about:

1. Key energy production, storage, transmission and utilisation technologies, including their cost and sustainability aspects over their life cycle

2. How to evaluate the technical characteristics and resources of some of the major renewable power sources and the performance of energy systems and machines related.

3. Develop preliminary design and dimensioning for wind, solar, hydro and hydrogen systems and perform preliminary technology assessment for unconventional energy resources (e.g., Waste Heat)

## Assessment

**Assessment language**

English

**Evaluation criteria and criteria for awarding marks**

Oral exam performance and exercises reports assignments performance will be equally weighted for course final grade.

## Required readings

Notes of the course

## Supplementary readings

- Supplementary in-depth research material suggested throughout the course