## Syllabus
### Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>HYDROPOWER AND WIND POWER SYSTEMS</th>
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<tbody>
<tr>
<td>Course code</td>
<td>45532</td>
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<tr>
<td>Scientific sector</td>
<td></td>
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<tr>
<td>Degree</td>
<td>Master Energy Engineering</td>
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<tr>
<td>Semester</td>
<td>1</td>
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<tr>
<td>Year</td>
<td>2</td>
</tr>
<tr>
<td>Academic year</td>
<td>2020/2021</td>
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<tr>
<td>Credits</td>
<td>12</td>
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<tr>
<td>Modular</td>
<td>yes</td>
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<tr>
<td>Total lecturing hours</td>
<td>76</td>
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<tr>
<td>Total lab hours</td>
<td></td>
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<tr>
<td>Total exercise hours</td>
<td>39</td>
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<tr>
<td>Attendance</td>
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<td>Prerequisites</td>
<td>EFM-HPP</td>
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<td>Course page</td>
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### Specific educational objectives

#### Module 1
**HYDROPOWER SYSTEMS**

- **Lecturer**: Prof. Maurizio Righetti; Dr. Giuseppe Maurizio Pisaturo
- **Scientific sector of the lecturer**: ICAR02
- **Teaching language**: English
- **Office hours**: 
- **Teaching assistant (if any)**: 
- **List of topics covered**:
  1. Description of Run-of-the-river Hydro Power plants, also through the detailed analysis of different plants already built
  2. Optimal plant site assessment and hydrological analyses
  3. Hydraulic design of Weir, intake, minimum vital flow outlet
  4. Hydraulic design of headrace silting basin, forebay
  5. Penstock and water hammer, water turbine house analysis and design

*Note for HPS: in total: 20 hours labs-exercises, 40 hours frontal lessons*

- **Teaching format**: Frontal lessons, laboratory and exercises

#### Module 2
**WIND POWER SYSTEMS**

- **Lecturer**: Prof. Battisti Lorenzo
- **Scientific sector of the lecturer**: ING/IND-08
- **Teaching language**: English
Office hours | On appointment
---|---
Teaching assistant (if any) | 
Office hours | 
List of topics covered | 1. Description of wind power plants, history, classification, uses, technology;  
2. Wind turbine design, steps and tools; (key elements of the design, definition of the activities and organization of time, budget management, technical norms);  
3. The fluid dynamic and geometric design of the rotor;  
4. The power control;  
5. The mechanical design and testing of the machine;  
6. Elements of analysis of wind resources and site assessment;  
7. Small wind turbines;  
8. Wind farms design;  
9. Economic and financial analysis;
Teaching format | Frontal lessons (40h), laboratory and exercises (20h)

Learning outcomes | Knowledge and understanding:
---|---
The Hydro Power module provides the knowledge for run-of-the-river (RoR) hydro power plant analysis and design. The frontal lessons and laboratory exercises will give the necessary in-depth analysis of hydraulic design of each component of a RoR Hydro Power Plant (and assistance to design during laboratory hours).

Wind energy course provides the basic knowledge for wind energy systems analysis and design. Main technical, and economical aspects for the proper selection and design will be faced and discussed. In particular small wind turbines application area and large wind farm design will be developed through two dedicated projects.

Applying Knowledge and understanding:  
during one or two visits to large and/or mini hydro power plants (scheduled during the course), the elements which compose the hydroelectric system will be analyzed and understood, through practical examples.

The wind power course makes use of lectures, with introduction and discussion of the general aspects of wind turbine design, project assignment, work in laboratory with commercial codes and group meetings to review the progress of the projects assigned.

Making judgments: student will be able to analyze and evaluate the potential performances of a HPP. Students will acquire ability to analyze technical and economic feasibility of small wind project and large wind farm projects.

Communication skills: (HS) For each visit a technical report has to be written by the student and discussed during oral exam.

Learning skills
Student will learn (second part of the “Hydropower systems” module) to develop in detail the hydraulic design of each compartment constituting a mini hydro power plant, including: weir, intakes, settling basin, head race, surge tank/forebay, penstock. The course will transfer knowledge and methods for the design of small wind turbines and wind farms. The draft design of a wind farm will be developed. Two visits will be organized.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Oral exams and exercises/report</th>
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<tbody>
<tr>
<td>Assessment language</td>
<td>English</td>
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<td>Evaluation criteria and criteria for awarding marks</td>
<td>The exam of wind power module consists on oral presentation and discussion of the projects and deliverables of the individual working groups, with the identification and evaluation of the contributions of individual participants.</td>
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**Required readings**
- Hydraulic structures (Novak)
- Hydraulic design of stilling basins (Peterka)
- Dam hydraulics (Vischer & Hager)

**Supplementary readings**
- L. Battisti Esercizi sulle turbine eoliche (edizione in corso)
- M.O. Hansen, AERODYNAMICS OF WIND TURBINES, Ed. James & James, 2003