

# Syllabus

## *Descrizione corso*

<b>Titolo insegnamento</b>	Fluid Machines Engineering
<b>Codice insegnamento</b>	45527
<b>Titolo aggiuntivo</b>	
<b>Settore Scientifico-Disciplinare</b>	IIND-06/A
<b>Lingua</b>	Inglese
<b>Corso di Studio</b>	Corso di laurea magistrale in Ingegneria energetica
<b>Altri Corsi di Studio (mutuati)</b>	
<b>Docenti</b>	prof. Lorenzo Battisti, Lorenzo.Battisti@unibz.it <a href="https://www.unibz.it/en/faculties/engineering/academic-staff/person/32901">https://www.unibz.it/en/faculties/engineering/academic-staff/person/32901</a>
<b>Assistente</b>	
<b>Semestre</b>	Primo semestre
<b>Anno/i di corso</b>	1
<b>CFU</b>	9
<b>Ore didattica frontale</b>	90
<b>Ore di laboratorio</b>	0
<b>Ore di studio individuale</b>	135
<b>Ore di ricevimento previste</b>	
<b>Sintesi contenuti</b>	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.
<b>Argomenti dell'insegnamento</b>	The course will cover the following topics: 1. Introduction a. Essentials of fluid Machines and Energy systems i. Elements of fluid dynamics

	<ul style="list-style-type: none"> <li>ii. Elements of Fluid Machinery</li> <li>iii. Elements of Energy systems</li> <li>b. Introduction to renewable energy</li> <li>2. Fluid machines for renewable energy <ul style="list-style-type: none"> <li>a. Solar Power <ul style="list-style-type: none"> <li>i. Solar Resource</li> <li>ii. Solar photovoltaic</li> <li>iii. Concentrated and thermodynamic solar</li> <li>iv. Utility and community scale</li> </ul> </li> <li>b. Hydro Power <ul style="list-style-type: none"> <li>i. Hydro Resource</li> <li>ii. Mini-hydro</li> <li>iii. Reversible turbines, PATs and variable speed hydro-turbines</li> <li>iv. Utility and community scale</li> <li>v. Diagnostics and fault detection</li> </ul> </li> <li>c. Wind Power <ul style="list-style-type: none"> <li>i. Wind resource and Terrain</li> <li>ii. Horizontal and vertical axis wind turbines</li> <li>iii. Utility and community scale</li> <li>iv. Diagnostics and fault detection</li> </ul> </li> <li>d. Waste Heat and Water <ul style="list-style-type: none"> <li>i. Waste Heat</li> <li>ii. Waste Water</li> </ul> </li> <li>e. Storages <ul style="list-style-type: none"> <li>i. Types of storage</li> <li>ii. P2X</li> <li>iii. Hydrogen Applications</li> <li>iv. Utility and community scale</li> </ul> </li> <li>f. Grid Management &amp; Economics <ul style="list-style-type: none"> <li>i. Smart Grids</li> <li>ii. Economic figures: LCA, ELCA, PBP, LCOE</li> </ul> </li> </ul> </li> </ul> <p>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.</p>
<b>Parole chiave</b>	Fluid Machinery; Hydro Power; Turbines; Wind Power; Storages
<b>Prerequisiti</b>	Fluid Machines, Thermodynamics, Mechanics.

<b>Insegnamenti propedeutici</b>	
<b>Modalità di insegnamento</b>	Frontal lessons, laboratory and exercises.
<b>Obbligo di frequenza</b>	Recommended.
<b>Obiettivi formativi specifici e risultati di apprendimento attesi</b>	<p>During the course, the student will gain knowledge about:</p> <ol style="list-style-type: none"> <li>1. Key energy production, storage, transmission and utilisation technologies, including their cost and sustainability aspects over their life cycle</li> <li>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.</li> <li>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).</li> </ol>
<b>Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)</b>	<ol style="list-style-type: none"> <li>1. Knowledge and understanding Demonstrates advanced knowledge of fluid machinery and energy conversion systems, including governing equations of pVT systems and fluid machineries. Understand the operating characteristics of fluid machineries. Know and understand the efficiency in elementary and complex systems.</li> <li>2. Applying knowledge and understanding Applies analytical and numerical methods to model pVT systems. Is able to design and select basic fluid machinery systems.</li> <li>3. Making judgements Makes informed decisions on the design and operation of fluid machinery in energy systems, considering operating parameters and efficiency. Critically evaluates data from experiments and simulations and assesses uncertainties.</li> <li>4. Communication skills Presents complex technical analyses clearly and effectively to specialist audiences, using appropriate technical language, graphical representations, and scientific reporting standards. Shows the capability to appropriately use technical terms.</li> <li>5. Learning skills Works independently and collaboratively, identifies learning needs,</li> </ol>

	and updates knowledge in response to technological advances in turbomachinery and energy engineering. Prepares for further research or professional practice.
<b>Modalità di esame</b>	<p>Written/Oral Exam and exercise report.</p> <ol style="list-style-type: none"> <li>1. Knowledge and understanding --&gt; Oral examination, At-home exercises</li> <li>2. Applying knowledge and understanding --&gt; Lab group exercises, At-home exercises</li> <li>3. Making judgements --&gt; Lab group reports, Oral examination</li> <li>4. Communication skills --&gt; Lab group reports/presentations, Oral examination</li> <li>5. Learning skills --&gt; At-home exercises, Lab teamwork, Oral examination</li> </ol>
<b>Criteri di valutazione</b>	Oral exam performance and exercises reports assignments performance will be equally weighted for course final grade.
<b>Bibliografia obbligatoria</b>	Notes of the course.
<b>Bibliografia facoltativa</b>	<ul style="list-style-type: none"> <li>• Twidell, John, and Tony Weir. Renewable energy resources. Routledge, 2015</li> <li>• Supplementary in-depth research material suggested throughout the course</li> </ul>
<b>Altre informazioni</b>	
<b>Obiettivi di Sviluppo Sostenibile (SDGs)</b>	Energia rinnovabile e accessibile, Lotta contro il cambiamento climatico, Città e comunità sostenibili