Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus

Course Description

Course Title	Fluid Machines Engineering
Course Code	45527
Course Title Additional	
Scientific-Disciplinary Sector	IIND-06/A
Language	English
Degree Course	Master in Energy Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Lorenzo Battisti, Lorenzo.Battisti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/32901
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	9
Teaching Hours	90
Lab Hours	0
Individual Study Hours	135
Planned Office Hours	
Contents Summary	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.
Course Topics	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 ii. Economic figures: LCA, ELCA, PBP, LCOE 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.
Keywords	Fluid Machinery; Hydro Power; Turbines; Wind Power; Storages
Recommended Prerequisites	Fluid Machines, Thermodynamics, Mechanics.
Propaedeutic Courses	

Teaching Format	Frontal lessons, laboratory and exercises.
Mandatory Attendance	Recommended.
Specific Educational Objectives and 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).
Specific Educational Objectives and Learning Outcomes (additional info.)	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. 2. Applying knowledge and understanding Applies analytical and numerical methods to model pVT systems. Is able to design and select basic fluid machinery systems. 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. 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. 5. Learning skills Works independently and collaboratively, identifies learning needs, and updates knowledge in response to technological advances in

	turbomachinery and energy engineering. Prepares for further research or professional practice.
Assessment	Written/Oral Exam and exercise report. 1. Knowledge and understanding --> Oral examination, At-home exercises 2. Applying knowledge and understanding --> Lab group exercises, At-home exercises 3. Making judgements --> Lab group reports, Oral examination 4. Communication skills --> Lab group reports/presentations, Oral examination 5. Learning skills --> At-home exercises, Lab teamwork, Oral examination
Evaluation Criteria	Oral exam performance and exercises reports assignments performance will be equally weighted for course final grade.
Required Readings	Notes of the course.
Supplementary Readings	• Twidell, John, and Tony Weir. Renewable energy resources. Routledge, 2015 • Supplementary in-depth research material suggested throughout the course
Further Information	
Sustainable Development Goals (SDGs)	Affordable and clean energy, Climate action, Sustainable cities and communities