Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Hydropower and wind power systems
Course code	45532
Scientific sector	ICAR/02 (Module 1) "Hydraulic and Marine Constructions and Hydrology" ING-IND/08 (Module 2) "Fluid Machinery"
Degree	Master Energy Engineering
Semester	1
Year	2
Academic year	2024/2025
Credits	12
Modular	yes

Total lecturing hours	30 + 40 +8
Total lab and exercise hours	30 + 10 + 2
Attendance	Not mandatory
Recommended preliminary knowledge	-
Connections with other courses	A strict connection with the course of Environmental Fluid Mechanics / Hydropower Plants, Fluid Machines Engineering and Electrical System Engineering, all of them preparatory for the design of Run of the River Hydro Power Plants
Course page	https://www.unibz.it/en/faculties/engineering/master-energy-engineering/course-offering/?academicYear=2024

Specific educational objectives	The course aims at providing the basic notions to understand the behavior and to design run of the river hydro power plants for hydroelectric energy production.

Module 1	**Hydropower Systems**
Lecturer	Prof. Maurizio Righetti Dr. Giuseppe Pisaturo
Scientific sector of the lecturer	ICAR/02
Teaching language	English
Office hours	Appointment by email
Teaching assistant *(if any)*	-
Office hours	-
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.
Professional applications of the covered topics	The topics studied will allow the student to find employment in companies, public and private bodies and professional firms for the design, planning, construction and management of works and plants for hydroelectric production, for the management of environmental and energy resources.
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.
Professional applications of the covered topics	
Teaching format	Frontal lessons, laboratory and exercises

Learning outcomes	**(1) 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.

(2) 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.

(3) Making judgments:
Students 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.

(4) Communication skills:
Students will improve their communication skills by learning how to write and discuss an auditing technical report after a visit to a plan

(5) 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

Assessment

Oral exams and exercises/report.

Formative assessment

Form	Length /duration	ILOs assessed
Report	During the course	(2), (3), (5)

Summative assessment

Form	%	Length /duration	ILOs assessed
Oral examination,	100	About 1 hour	All except (5).

	including presentation and discussion of the report			
Assessment language	English			
Evaluation criteria and criteria for awarding marks	The exam of hydro power module and 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.			

Required readings	• Hydraulic structures (Novak) • Hydraulic design of stilling basins (Peterka) • Dam hydraulics (Vischer & Hager) • Slides and course materials
Supplementary readings	• L.Battisti. GLI IMPIANTI MOTORI EOLICI Ed. Lorenzo Battisti Editore. 2012 • L. Battisti Esercizi sulle turbine eoliche (edizione in corso) • T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi, WIND ENERGY HANDBOOK ed. Wiley 2001 • J.F. Manwell, J.G. McGowan, A.L. Rogers, WIND ENERGY EXPLAINED ed. Wiley 2002 • R.Harrison, E. Hau, H. Snel, LARGE WIND TURBINES, ed John Wiley & Sons, 2000 • M.O. Hansen, AERODYNAMICS OF WIND TURBINES, Ed. James & James, 2003. • R. Pallabazzer, SISTEMI EOLICI, Ed. Rubettino 2002