**Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
a.y. 2024/2025 (XL cycle)**

the course is open to students from other PhD cycles or programs,
and they may choose to participate in individual sections

1. Title
Introduction to Electrical Power Systems, Wind Energy and Wind Turbine Foundations

2. Course description
The course intends to describe the main technical aspects inherent Electrical Power Systems, focusing on wind energy and wind turbines. It is divided into three parts, which can also be taken individually, and 9 lessons:

Part I: electrical energy - *prof. Stefano Bracco, DITEN*

Lesson 1 (2 hours) describes the architecture of the electrical power system of a developed country

Lesson 2 (2 hours) is focused on the description of the main characteristics of power generation technologies

Part II: wind energy and wind turbines - *prof. Luisa Pagnini, DICCA*

Lesson 3 (3 hours): describes wind turbine typologies, technologies and wind turbine components. Optimum production. Basic concepts of wind turbine aerodynamics, force acting on a blade and active control.

Lesson 4 (3 hours) describes wind in the atmospheric boundary layer, wind resource assessment, power curve, power production

Lesson 5 (3 hours) introduces structural issues, feasibility assessment, economic indicators, cost benefit analysis.

Part III: wind turbine foundations – *prof. Riccardo Berardi, DICCA*

Lesson 6 (2 hours) deals with foundation types (focusing mainly on onshore turbines), loads and ULS/SLS requirements, site preparation and site stability.

Lesson 7 (2 hours) deals with gravity-based foundations, introducing stability analysis by failure envelopes under general loads and approaches for settlement/rotation assessment.

Lesson 8 (3 hours) deals with pile-supported foundations (single pile and pile group analyses). Ground anchors and ground improvement as supplementary foundation techniques.

Lesson 9 (2 hours) consists of case study discussion.

3. Course Organization
The course consists of lectures and technical applications. Lectures will be held by person with the possibility of online connection on Teams for those unable to participate in the classroom.

4. Teachers
Prof. Riccardo Berardi (DICCA), prof. Stefano Bracco (DITEN), prof. Luisa Pagnini (DICCA).

5. Duration and credits
The whole course consists of 9 lessons for a total of 22 hours and **4.5** credits.

To facilitate the participation of students from different backgrounds, the course is divided into distinct parts for which students can enroll. Students can apply for the full course, for **4.5** credits, or for Part I and II, for **2.5** credits. Students must specify whether they intend to enroll in the full course or just parts of it.

6. Activation mode and teaching period

The course is annual and will be held in January / February 2025. The minimum number of participants to activate the course is 5. Part III will not be activated if the number of students enrolled is less than 5.

7. Deadline for registration

Registrations should be submitted preferably by 31st Dec. 2024 by e-mail to: luisa.pagnini@unige.it

8. Final exam

Oral exam or written work.

9. References

P. Breeze. "Power Generation Technologies". Newnes 2019.

Guidelines for Design of Wind Turbines. Det Norske Veritas (Certification@risoe.dk) 2002.

E. Hau. "Wind turbines. Fundamental, technologies, application, economics". Springer-Verlag, Berlin, Heidelberg, 2006.

IEC 61400-12-1, "Wind turbines: Part 12.1 - Power performance measurements of electricity producing wind turbines". International Electrotechnical Commission, Geneva, Switzerland, 2005.

IEC 61400-1, "Wind energy generation systems – Part 1: Design requirements" – BSI Standards Publication, October 2019.

P.S.R. Murty. "Electrical Power Systems". Elsevier Ltd, 2017.

E. Simiu, R.H. Scanlan. "Wind effects on structures". John Wiley, New York, 1996.