

**Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
a.y. 2023/2024 (XXXIX cycle)**

(possibility of participation for students in other PhD cycles or other PhD courses
also following only Parts I and II for students from fields other than civil engineering)

1. Title

Introduction to Electrical Power Systems, Wind Energy and Wind Turbines

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 articulated into 10 lessons:

Part I: electrical energy

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

Lesson 3 (2 hours) depicts main typologies of wind turbines, dealing also with wind energy technology and wind turbine components.

Lesson 4 (2 hours) supplies main elements inherent the wind in the atmospheric boundary layer, dealing with mean wind and atmospheric turbulence.

Lesson 5 (2 hours) describes optimum production and the basic concepts of wind turbines aerodynamics, dealing with force acting on a blade and active control.

Lesson 6 (3 hours) deals with wind resource assessment, power production, cost benefit analysis.

Part III: wind turbine foundations

Lesson 7 (2 hours) deals with foundation types (focusing mainly on onshore turbines), loads and USL/SLS requirements, site preparation and site stability.

Lesson 8 (2 hours) deals with gravity-based foundations, introducing stability analysis by failure envelopes under general loads and approaches for settlement/rotation assessment.

Lesson 9 (3 hours) deals with pile-supported foundations (single pile and pile group analyses). Ground anchors and ground improvement as supplementary foundation techniques.

Lesson 10 (2 hours) consists of case study discussion.

3. Course Organization

The course consists of lectures and technical applications.

4. Teachers

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

5. Duration and credits

The course consists of 10 lessons for a total of 22 hours, 4.5 credits (or 2.5 credits - Part I and II only)

6. Activation mode and teaching period

The course is annual and will be held in January / February 2024. The minimum number of participants to activate the course is 5.

7. Deadline for registration

The deadline for applications is 31st Dec. 2023. Confirmation can be sent 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.