UCLouvain

lelec2753

2023

Electrical power systems: advanced topics and smart grids

5.00 credits	30.0 h + 15.0 h	Q2

Teacher(s)	De Jaeger Emmanuel ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Main themes	• Challenges in electrical power systems facing increasing decarbonization, decentralization and digitalization • Power systems evolution with focus on anticipating and resolving issues related to the increasing electrical power generation from renewable energy sources and the electrification of energy usages • Smart Grids
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 **Contribution of the course to the program objectives** In view of the LO frame of reference of the "Master Electrical Engineering", this course contributes to the development, acquisition and evaluation of the following learning outcomes: - AA1.1, AA1.2, AA1.3 - AA2.1, AA2.2 - AA3.3 - AA6.1 **Specific LO of the course** Specifically, at the end of the course, students will be able to: • Understand the technical and economic challenges for electrical power systems, anticipating and resolving issues related to the increasing electrical power generation from renewable energy sources. • Explain the characteristics and features, and models power electronic systems used in the context of the transmission and distribution of electricity, • Design and analyse micro-grids, including control, in particular incorporating various low-carbon technologies and distributed energy resources • Master specific engineering and calculation questions related to the mentioned themes Transversal learning outcomes: • Use of specialized software tools • Review published research related to smart grids • Address the question of the changing energy landscape, particularly the role of renewable energies and the new challenges linked to them (to be taken up by the various actors in the power systems)
Evaluation methods	*Students are assessed during a written and/or oral examination dealing with both theoretical concepts and the discussion of the various concepts discussed during the course.* *Half of the final mark will be awarded to the seminars, homework and projects assessment.* Note: The use of generative AI software such as chatGPT is permitted only for assistance in writing of the reports or preparing the seminars requested in this course. In this instance, however, an appendix will be required detailing, for each of the sections concerned, how the AI was used (information search, drafting and/or correction of the text, ...). Furthermore, external sources of information must be systematically cited in compliance with bibliographic referencing standards.
Teaching methods	• *Lectures* • *Seminars given by the students on the basis of scientific and technical literature* • *Related engineering practice based on small projects and supervised homework*
Content	Electrical energy networks currently appear to be central elements of the energy transition. They are the seat of major technological challenges resulting from developments and evolutions such as the growing electrification of some energy uses (mobility, heating systems, industrial systems...), the massive integration of renewable energy sources, electrical storage, etc. These challenges affect the planning, operation and management of these complex systems, which are at the heart of the content of this course. Major addressed topics: • Smart grids management of the massive integration of Distributed Energy Resources in power systems,

	active demand and energy storage management and control, active network management, evolution of the concept of ancillary services, transmission grids: HVDC links and Flexible AC Transmission Systems, supergrids, micro-grids, modern power systems monitoring and automation smart metering • Introduction to data analytics and artificial intelligence for power systems • Introduction to markets and regulatory schemes, including TSO-DSO coordination, taking into account significant increase in Distributed Energy Resources and their participation in various electricity markets.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=748
Bibliography	Reference textbooks *Electric Energy Systems - Analysis and Operation* (A. Gomez-Exposito, A.J. Conejo, C. Canizares) *Handbook of Electrical Power System Dynamics* (M. Eremia, M. Shahidehpour) • Copy of the slides Complementary documentation
Other infos	• It is recommended to have previously completed at least the course LELEC2520 or an equivalent. According to the opportunities and practical availability, the course can be completed by a technical visit and / or seminars given by experts from industry
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Energy Engineering	NRGY2M	5		