UCLouvain

lelec2520

2024

Electrical power systems

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	De Jaeger Emmanuel ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Knowledge and practical application of the theory of electrical circuits and electromechanical converters, as covered in the courses LELEC1370 and LELEC1310
Main themes	• Introduction to electric energy systems (generation, transmission, distribution, storage and end-use of electric power and their respective developments • Positioning of electricity as energy vector, electric energy systems overview and outlook, • Structure and architectures of electric power systems, • Modelling, calculation and optimization of electric power systems in steady state, • Planning and operation of electric power systems, • Introduction to economics of power systems and electricity markets, • Introduction to Smart Grids
Learning outcomes	**At the end of this learning unit, the student is able to :** **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** 1 • Remember the main orders of magnitude and units in the field of electrical energy systems and more specifically power grids assets, • Understand the main technical features, functionalities and operating modes of public electricity transmission and distribution networks as well as industrial electricity distribution networks, • Understand technological specificities and apply relevant theoretical principles to model the main components of power systems (power transformers, lines, cables, sources, loads, FACTS) and solve general problems of load-flow calculation, • Use the previous competences in order to investigate and analyse practical situations, and solve technical problems regarding planning and operation of power systems in steady-state (including voltage control, frequency and power control, grid optimal and secure operation) • Understand the main principles of electric power systems economics
Evaluation methods	Students will be assessed: - Based on a project carried out in groups of two during the semester; - Individually on the basis of a written or oral examination relating to the content of lectures and practice sessions To constitute the final mark, the weighting given to the project is: - 33% if the mark of the individual exam is higher than 10/20; - 0% if the mark of the individual exam is less than 8/20; - linearly progressive between 0%, if the individual exam mark is 8/20, and 33%, if the exam mark is 10/20 The project cannot be redone; the mark is acquired in the first quadrimester and kept in the event of a second session. Note: The use of generative AI software such as chatGPT is permitted only for assistance in writing of the reports 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* • *Practical sessions (supervised exercise sessions).* • *Project to be carried out by groups of two students, based on the use of dedicated software for power systems design and analysis (This project is evaluated and taken into account in the final evaluation grade.)* *Technical visit (e.g. training centre ELIA, Belgian transmission high voltage grid operator, and the national dispatching.)*
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 processes and 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: • Electricity as energy carrier, architecture and constitution of power systems, • Power systems physical concepts and modelling: transmission and distribution links (power transformers, lines, cables), generators and sources (synchronous machines, renewable energy conversion systems), power electronics devices used for grid control and operation (HVDC links, Flexible AC Transmission Systems), • Load-Flow calculation, • Electrical power systems planning concepts, • Optimal and secure operation of power systems (Optimal Power Flow, units commitment and economic dispatch problems, contingency analysis), • Frequency and power control, • Voltage control, • State-estimation, • Balanced faulty operation (short circuit), basic introduction to power grids protections.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=1120
Bibliography	• Reference textbook: *Electric Energy Systems - Analysis and Operation* (A. Gomez-Exposito, A.J. Conejo, C. Canizares) • Copy of the slides • Complementary documentation
Other infos	An optional test is organized in the middle of the semester. Successful completion of this test might result in a bonus point for the final mark (details on moodle)
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		🔍