UCLouvain

# lelec2753

*2020*

# Electrical Power Systems: Advanced Topics

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

| 5 credits | 30.0 h + 15.0 h | Q2 |
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| Teacher(s) | De Jaeger Emmanuel ; |
| Language : | English |
| Place of the course | Louvain-la-Neuve |
| Main themes | • Dynamic modelling, control and analysis of transient behaviour of power systems, especially in the significant presence of power generation units from renewable sources (wind, photovoltaic, marine and others)<br>• Applications of power electronics to the management of electrical energy and power grids, in particular (transmission networks: Flexible AC Transmission Systems (FACTS), DC link (HVDC); distribution networks (D-FACTS, active filters))<br>• Smart Grids: active demand management, energy storage, management of the massive integration of distributed generation in distribution networks, evolution of the concept of ancillary services, micro-grids, power systems monitoring and automation. |
| Aims | In consideration of the reference table AA of the program "master in electrical engineering ", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning:<br>• AA1.1, AA1.2, AA1.3<br>• AA3.1, AA3.3<br>• AA5.6<br>• AA6.1<br>Specifically, at the end of the course, students will be able to:<br>1 • Model electrical power systems and study their dynamic behaviour, especially with the help of specialized software tools,<br>• Explain electrical features and dynamic models of electricity generating units from renewable sources,<br>• Explain the characteristics, features and models of power electronic systems used to manage the transmission and distribution of electricity,<br>• Understand the technical challenges for electric power systems, anticipating and resolving issues related to the increasing electrical power generation from renewable energy sources.<br>Transversal learning outcomes:<br>• Use of specialized software tools<br>• 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)<br>- - - -<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".* |
| Evaluation methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>Students are assessed during an oral examination, for which they can have the courses and their personal notes supports.<br>Homework is proposed during the semester and is evaluated. It counts for half of the points of the final grade, *provided that the student has obtained at least 50% of the points for the exam* .<br>In case the student does not obtain at least 50% of the points for the exam, the final grade is equal to the grade obtained for the exam. |

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| Teaching methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>• Lectures for the introduction of the basic theoretical concepts and general context description<br>• Exercises and homework: solving particular problems with the help of dedicated software tools. Discussion forum, practical issues concerning the use of software tools and results. Consulting sessions (coaching).<br>• Seminars based on reading recent scientific articles dealing with topics covered in the course. These readings are intended to deepen and illustrate the concepts developed during the lectures. They concern case studies or results of particular investigations. Everyone is asked to read the articles in advance. Each reading will be particularly prepared by a group of two students who will be asked to present it to the group, to comment on it and to animate a debate. |
| Content | • Generalities, a reminder of basic concepts of electricity networks<br>• Dynamic modelling of systems:<br>1. Synchronous machines (Park's model, simplified models, characteristic parameters),<br>2. Wind turbine generators (cage induction motors, doubly-fed induction machines, permanent magnet synchronous machines and associated power electronic converters),<br>3. Photovoltaic systems,<br>4. Power electronics converters used in the technical management and operation of energy networks: HVDC links, FACTS,<br>5. Other network components and loads,<br>6. Energy Storage Systems.<br>• Introduction to the concepts of stability<br>• Introduction and use of specialized software tools for the analysis of the dynamic behaviour of electrical systems<br>• Smart Grids: current issues (technical management of networks (congestion, stability, voltage control ...), ancillary services, the role of energy storage etc.) |
| Inline resources | Moodle<br>http://moodleucl.uclouvain.be/course/view.php?id=5473 |
| Bibliography | • P. Kundur, Power System Stability and Control, McGraw-Hill Inc.<br>• Transparents du cours<br>• Recueil de documentation |
| Other infos | It is recommended to have previously completed the course LELEC2520 or an equivalent<br>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) | | | | |
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| Program title | Acronym | Credits | Prerequisite | Aims |
| Master [120] in Electrical Engineering | ELEC2M | 5 | | |
| Master [120] in Electro-mechanical Engineering | ELME2M | 5 | | |