UCL Université catholique de Louvain

LELEC2520

2014-2015

ELECTRIC POWER SYSTEMS

5.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	De Jaeger Emmanuel ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	Slides, exercices and solutions on iCampus > icampus.uclouvain.be/claroline/course/index.php?cid=ELEC2520
Prerequisites :	None
Main themes :	-- Generalities about the generation, transmission, distribution, storage and end-use of electric power and their respective developments, -- Structure and architectures of electric power systems , -- Modelling and calculation of electric power systems in steady state and fault conditions (short circuit) -- Questions related to the planning and operation of electric power systems (frequency and power control, voltage control, protection, ...) -- Introduction to Smart Grids
Aims :	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 Specifically, at the end of the course, students will be able to: 1. Architecture of electrical systems: -- Describe and explain the main features, functionality and procedures of public electricity transmission and distribution networks and industrial distribution networks 2. Modelling tools and calculation: -- Establish and use the equivalent circuit of a symmetrical three-phase network with or without neutral, -- Explain the principles of the calculation in relative units (per unit) and use them as part of the resolution of numerical problems, -- Explain and interpret the physical components of Fortescue -- Use the Fortescue components to analyze situations and solve problems relating to the operation of unbalanced networks 3. Power grids components: -- Describe and explain the operating principles of transformers, their coupling modes, their conditions of use in parallel. Describe, explain and use their equivalent circuits, -- Explain the physical bases and principles for calculating primary and secondary parameters of overhead lines; explain the PI equivalent scheme of power lines and its simplified versions, -- Explain the physical principles of the complex power transmission on a power line, the notions of characteristic impedance and natural power, -- Describe and explain the phasor diagram of a generator connected to a power grid, -- Explain the concepts of gross and net power produced by a generator; calculate the active and reactive power exchanged between a generator and the network to which it is connected through a coupling transformer. -- Use all of these concepts to analyze practical situations and solve problems (numerical exercises). 4. Design and operation of power systems: --

	Explain the fundamentals of computing power flow in a meshed network and manually apply them in simple situations, -- Analyze and interpret the results of a calculation of power flow obtained using specialized software tools -- Explain the different voltage control techniques, discuss the criteria for choosing a proper technique in a given situation, solve problems related to voltage control, -- Explain the principles of frequency primary control and secondary load-frequency control and apply them in practical situations, -- Explain the basic principles of tertiary control of the generation of electrical energy (economic dispatching) and apply them in simple practical situations, -- Manually calculate balanced and unbalanced short circuit (fault) currents in simple situations, -- Explain the basic principles of the protection of transmission and distribution networks and apply them in practical situations. Transversal learning outcomes: -- Structure, detail and present an engineering calculation report -- Use professional software tools ("commercial" software) *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 :	Students are assessed during an oral examination on both the theory and concepts and the discussion of practical situations (practical industrial case study, numerical exercises). Students may have the courses and their personal notes supports. The examination mark accounts for 75% of the final grade. The mark of a small project proposed during the semester comes to 25% of the final grade.
Teaching methods :	-- Lectures -- Practical sessions (supervised exercise sessions). -- Project type exercise to be performed by groups of two students, based on the use of software for calculating and analyzing networks. (This exercise evaluated and taken into account in the final evaluation grade.)
Content :	-- Electricity as energy carrier, architecture of power systems, voltage systems (continuous alternating ¬) per unit system, component systems (Fortescue, Clarke), -- Modelling: three-phase transformers, transmission and distribution links (lines, cables), generators (steady-state, operating range, excitation systems, models for calculating short circuits currents), -- Power Flow in a meshed power network, state estimator, -- Voltage control, -- Frequency and power control, tertiary control of electricity generation, notions of managing a set of generation units -- Electrical power systems planning concepts -- Unbalanced and faulty operation (short circuit), power grids protections
Bibliography :	-- Copy of the slides -- Complementary documentation -- Reference textbook
Other infos :	According to the opportunities and practical availability, the course can be completed by a technical visit (eg, visiting the training center ELIA, Belgian transmission high voltage grid operator, and the national dispatching.)
Cycle and year of study :	> Master [120] in Electro-mechanical Engineering > Master [120] in Electrical Engineering
Faculty or entity in charge:	ELEC