Course Unit	Intelligent Electrical Grids			Field of study	Energy								
Master in	Electrical and Computers Engineering			School	School of Technology and Management								
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0						
Type	Semestral	Semester	2	Code	5070-792-1203-00-23								
Workload (hours)	162	Contact hours	T -	TP 20	PL 20	TC -	S -	E -	OT 20	O -			

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Ângela Paula Barbosa da Silva Ferreira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. understand the fundamental management diversity and commercial issues of the renewables/sustainable low-carbon technologies portfolio;
2. understand the main components of power systems, including FACTS devices and their functionalities;
3. evaluate the behavior of the electric power system at steady and dynamic levels;
4. understand the modelling of distributed generation and micro sources within microgrids and the associated control strategies;
5. implement solutions towards the digital transformation of the electric power system.

Prerequisites

Before the course unit the learner is expected to be able to:
1. understand the basis of power systems organization and operation;
2. understand numerical methods to solve nonlinear equations;
3. understand the fundamentals of electrical machines;
4. use programming languages.

Course contents

Sustainable low-carbon technologies. Power Systems Analysis. Grid and microgrid operation and control. Digitalisation of electrical networks.

Course contents (extended version)

1. Sustainable low-carbon technologies.
   - Classical and emerging technologies based on sustainable energy sources.
   - National and European energy policies.
   - Energy markets.
   - Storage systems.
   - Power systems flexibility: integrating short- and long-term flexibility solutions.
2. Power systems analysis.
   - Modelling of main elements.
   - Power flow analysis.
3. Grids and microgrids operation and control.
   - Direct current and alternating current microgrids.
   - Control strategies.
4. Digitalisation of electrical networks.
   - Components, architectures and technologies.
   - Data transmission and connectivity.

Recommended reading

1. Chow, J. H. and Sanchez-Gasca, J. J. (2020). Power System Modeling, Computation, and Control, IEEE Press, Wiley.
2. Kyriakopoulos, G. L., Ed(s) (2021). Low Carbon Energy Technologies in Sustainable Energy Systems, Academic Press.
3. Bahrami, S. and Mohammadi, A. (2019). Smart Microgrids: From Design to Laboratory-Scale Implementation, Springer.
4. Buchholz, B.M. and Styczynski, Z. A. (2020). Smart Grids: Fundamentals and Technologies in Electric Power Systems of the Future, 2nd Edition, Springer.
5. Al-Turjman, F. (2019). Intelligence in IoT-enabled Smart Cities, CRC Press.

Teaching and learning methods

Course contents are introduced using formal lectures, seminars, and invited lectures by professionals from the energy sector. Solving practical problems is suggested in practical and laboratory classes to support the expected learning outcomes.

Assessment methods

1. Distributed assessment - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 50%
   - Final Written Exam - 50% (It is required a minimum classification of 25%.)
2. Global assessment - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Ângela Paula Barbosa da Silva Ferreira	José Luís Sousa de Magalhaes Lima	João Paulo Ramos Teixeira	José Carlos Rufino Amaro
06-03-2024	06-03-2024	13-03-2024	16-03-2024