Curricular Unit Sheet

1. Curricular Unit Syllabus.

1.1. Curricular Unit

Planning and Operation of Electrical Energy Networks - POREE

1.2. Scientific area acronym

Electrical Engineering

1.3. Duration

1 Semester

1.4. Total of Working Hours

Campo alfanumérico (100 carateres).

1.5. Contact hours

4,5 hours

1.6. ECTS

6

1.7. Observations

2. Responsible Academic staff and lecturing load in the curricular unit (enter full name)

Francisco Alexandre Ganho da Silva Reis (Responsible)	1.5 h – Theory 1.5 h – Exercises
João José Oliveira Lopes	1.5 h Practical/Lab

3. Other academic staff and lecturing load in the curricular unit

Campo alfanumérico (1.000 carateres).	

4. Learning outcomes of the curricular unit

1. Acquiring knowledge to solve problems in the electrical power production field both on steady-state and transient conditions.
2. Performing a complete steady-state analysis applying planning criteria.
3. Performing a short circuit analysis involving both symmetrical and unsymmetrical faults.
4. Analyzing the problems caused by temporary overvoltages.
5. Understanding the concept of flexibility in the context of smart grids
6. Using the PSS/E software to simulate electrical power systems and complement some concepts with MathCad.

7. Using ATP software to simulate transients in electrical power systems.
8. Exposing solutions with both technical and communicational efficiency.

5. Syllabus

1. Load flow analysis.
2. Planning criteria for electrical power systems.
3. Short Circuit Analysis
4. Transient analysis in power systems. Types of overvoltage protections.
5. Quality of service in electrical power systems.
6. Flexibility sources in power systems in the context of smart-grids

6. Demonstration of the syllabus coherence with the curricular unit's objectives

1. Simulation of a real electrical network in steady-state, using the “Power flow” module of the PSS/E software, and analysis of generation and grid planning problems.
2. Calculate the Short Circuit Power in the network
3. Oral presentation of works and discussion.

7. Teaching methodologies (including evaluation)

In the theoretical classes (T) the contents of the UC are taught. Under theoretical-practical (TP) classes, practical case problems are presented and solved, aligned with the contents taught in the theoretical component. In laboratory classes (PL), the knowledge acquired is applied carrying out laboratory teamwork.

1 final test, Final exam and Recovering exam

2 practical exercises with oral presentation and discussion

8. Demonstration of the coherence between the teaching methodologies and the learning outcomes

The main purpose of this curricular unit is to introduce students through domains of theoretical approaches as well as through domains of computer simulation for the analysis of both steady-state and short circuit analysis as well as some transient phenomena that usually occurs in electric power systems.
Special emphasis is done on the steady-state analysis, planning criteria of real-based electrical power systems. Also an importance is given to the short circuit calculation trying to ensure that students learn professional, technical and communicational skills in these domains.
The management of flexibility sources by the system operators will be briefly introduced in the context of smart-grid to solve specific issues like reactive power management, active system management amid others.

9. Bibliography

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3. R. C. Dugan, M. F. McGranaghan, H. W. Beaty, *Electrical Power Systems Quality*, McGraw-Hill, 1996
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5. Exercícios de Redes de Energia Elétrica de Eduarda Pedro e Rui Castro ISBN: 9789898481283 (in Portuguese)
6. P. M. Anderson, *Analysis of faulted power systems*, McGraw-Hill, IEEE Press, 1995
7. ENTSO-E, Network Connection Codes (RfG, DCC)
8. Insulation Coordination in High-Voltage Electric Power Systems: W. Diesendorf London Butterworths 1974