Curricular Unit Sheet

1. Curricular Unit Syllabus.

1.1. Curricular Unit

Electric Power Systems Quality

1.2. Scientific area acronym

EE

1.3. Duration

Semester

1.4. Total of Working Hours

162

1.5. Contact hours

T (22,5) + TP (22,5) + PL (22,5) = 67,5

1.6. ECTS

6

1.7. Observations

Optional

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

Paulo José Duarte Landeiro Gambôa	9 hours

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

Miguel Cabral Ferreira Chaves	3 hours

4. Learning outcomes of the curricular unit

- This course aims at the acquisition of knowledge in the area of Power Quality;
- Students acquire skills to diagnose problems of power quality;
- Students learn to use preventive and remedial solutions to mitigate them.

5. Syllabus

- Power Quality;
- Concepts, definitions, indicators and cost;
- Types of deformation of the waveform of current and voltage;
- Regulatory and quality standards (EN50160, IEC61000, IEC62040, IEEE Std 519-2014, IEEE Std 1459-2010, RQS);
- Monitoring;
- Disturbances caused by conversion systems switched;
- Preventive and remedial solutions.

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

- Using numerical simulation programs (Matlab/Simulink), with their mathematical models to reproduce the main types of deformation wave voltage and current waveform and some mitigation solutions.
- Presentation and discussion with students in practical cases.
- Key indicators, examples and experimental framework in its existing regulations.

7. Teaching methodologies (including evaluation)

Lectures given acetates using powerpoint, numerical simulations and presentation of scientific articles. Theoretical/practical problem solving, interpretation of results and discussion of solutions. Practical classes in the computer lab using the software Matlab/Simulink for modeling and simulation of specific cases. Demonstration tests in the laboratory.

- The theoretical and Theoretical/Pratical grade, T, is is obtained with the correction of problems and research works. This grade must be equal or greater than 9,5 (nine point five values), in a 20-point grading scale, in order to obtain approval at the curricular unit;
- The practical grade, P, is the assigned to the practical reports, and the formative evaluation, assigned by the laboratory class teacher. This grade must be equal or greater than 9,5 (nine point five values), in a 20-point grading scale, in order to obtain approval at the curricular unit;
- The unit final grade, FG, is given by $2/3 \times T + 1/3 \times P \geq 10$.

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

- Using numerical simulation programs (Matlab/Simulink) with their mathematical models to reproduce problems of power quality and some mitigation solutions;
- Conducting laboratory tests on power quality*;*
- Presentation and discussion with students in practical cases.

9. Bibliography

- Fernando Alves da Silva, "*Qualidade de Energia Eléctrica*", Textos de apoio;
- Fernando Alves da Silva, "*Guias dos Trabalhos Laboratoriais*";
- Paulo Gambôa, "*Qualidade de Energia Eléctrica*", Textos de apoio;
- EDP, "*Manual da Qualidade da Energia Eléctrica*", EDP, Dezembro 2005;
- Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, "*Electrical Power System Quality*", MacGraw Hill, 2003, ISBN: 0-07-138622-X;
- Math H.J. Bollen, M., "*Understanding Power Quality Problems*", Wiley-Interscience, 2000, ISBN 0-7803-4713-7;
- Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "*Power Quality Problems and Mitigation Techniques*", John Wiley and Sons Ltd, ISBN:9781118922057, 2015;
- Jaroslaw Guzinski, Haitham Abu-Rub, Patryk Strankowski, "*Variable Speed AC Drives with Inverter Output Filters*", Wiley, ISBN: 978-1-118-78289-7, 2015;
- Suresh Mikkili, Anup Kumar Panda, "*Power Quality Issues: Current Harmonics*", CRC Press, ISBN 9781498729628, 2015;
- Ali Emadi, Abdolhosein Nasiri, Stoyan B. Bekiarov, "*Uninterruptible Power Supplies and Active Filters*", CRC Press, ISBN 9780849330353, 2004;
- Alexander Kusko, Marc T. Thompson, "*Power Quality in Electrical Systems*", The McGraw-Hill Companies, Inc, ISBN: 9780071470759, 2007;
- Ewald Fuchs and Mohammad A. S. Masoum, "*Power Quality in Power Systems and Electrical Machines*", Elsevier Inc, ISBN: 978-0-12-800782-2, 2015;
- Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, "*Energy Storage in Power Systems*", John Wiley & Sons, Ltd., ISBN:9781118971321, 2016;