Curricular Unit Sheet

1. Curricular Unit Syllabus.

1.1. Curricular Unit

Intelligent Control

1.2. Scientific area acronym

EE

1.3. Duration

Semestral

1.4. Total of Working Hours

162h

1.5. Contact hours

T:22,5; TP: 22,5; PL:22,5

1.6. ECTS

6

1.7. Observations

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

Carla Solange Pires Correia Viveiros	45h

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

Luís José Lamy Rocha Encarnação	22,5h

4. Learning outcomes of the curricular unit

- Study techniques of intelligent control, in its theoretical and laboratory components;.
- Understand concepts regarding the identification of linear dynamic systems;
- Study adaptive control techniques and develop a project of adaptive controllers by pole placement;
- Study artificial neural network as approximation of non-linear dynamics and develop a neuronal control architecture;
- Study fuzzy logic as an approximation of nonlinear dynamics and develop a fuzzy controller design.

5. Syllabus

The program content is based on the following topics:

Identification of Linear Dynamic Systems: Description of the problem; Stages of the identification process; Linear models invariant in Time; Parameter estimation: least squares method; Validation of models; Recursive quadratic least squares method.

Adaptive Control: Some functional models; Design by pole placement.

Artificial Neural Networks: The neuron as a base element; Activation functions; Multi-layered proactive neural networks; Approximation properties; Supervised training in multilayer networks; Generalization and validation; Neural control architectures.

Fuzzy Logic Control Techniques: Fundamentals of fuzzy systems; Diffusification of temporal variables; Inference with linguistic variables; Diffusion of linguistic variables; Project of fuzzy controllers.

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

The syllabus aims at the acquisition of skills by students in the following areas:

- Identification of linear dynamic systems;
- Development and application of controllers by pole placement;
- Study of approximation techniques of non-linear dynamics;
- Development and application of neural controllers;
- Development and application of fuzzy controllers.

The objectives of the course clearly summarize the skills to be acquired by students, which are according to the syllabus presented.

7. Teaching methodologies (including evaluation)

The teaching reflects the aspects: theoretical, theoretical-practical and laboratory.

In the theoretical component the theoretical foundations of the program are approached in a bidirectional way between teacher and student.

In the theoretical-practical component, the application of the acquired knowledge is put into practice through the mathematical resolution of problems in a simulation environment and posterior validation.

In the laboratory component are presented the objectives and competences to be acquired by the students in each work within a predefined time horizon to fulfill these objectives.

The assessment of knowledge consists of a theoretical component and a practical component. The evaluation of the theoretical component is done through a final exam and the practical component through the presentation and discussion of 3 laboratory works. These two components are pedagogically essential for approval. The theoretical component

has a weight of 60% and the laboratory component a weight of 40%, in the final classification of the UC, and in each of the practical work, the classification can not be less than 8.0 values and, the final classification can not be less than 10,0 values (practical component). In the exam, the classification can not be less than 10 values (theoretical component);

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

The methodology adopted for the laboratory classes contributes to the consolidation and construction of knowledge since the students define the process, methodology and apply the theoretical knowledge, contributing to the synergy between the classes of the theoretical components, theoretical-practical and laboratory.

9. Bibliography

- *System Identification*, Lennart Ljung, 1987.
- *System Identification and Control Design*, I. Landau, 1990
- *Digital Control of Dynamic Systems*, G. Franklin, J. Powell, M. Workman, 1998
- *Adaptive ControlL Systems*, R. Isermann, K. H. Lachmann and D. Matko, 1992
- *Feedback Control of Dynamic Systems*, G. Franklin, J. Powell, A. Naeini, 2006
- *Neural Network Design*, M. Hagan, 1996
- *Neuro-Fuzzy and Soft Computing*, Jang, Sun e Mizutani, 1995
- *Fuzzy Control and Identification*, John H. Lilly, 2010.
- *Fuzzy Control and Modeling*, H. Ying, 2000.
- *Fuzzy and Neural Approaches in Engineering,* J. Hines, 1997