# Course Syllabus for
## DAUSY National Ph.D. Program in Autonomous Systems
## (year 2023-24)

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| **Course title** | Intelligent Control Systems |
| **Scientific Discipline Sector** | ING-INF/04 |
| **Hours of instruction** | 20 hours |
| **CFU** | 2 CFU |
| **Semester, period** | January-February 2024 |
| **Goal** | This course aims at providing PhD students with modelling and methodological tools for formulating and solving control problem using intelligent architectures such as neural networks and fuzzy systems.

During the course several problems will be formalized, particularly referred to relevant issues within management and industrial engineering. Problem definition and resolution will be also implemented in simulation and engineering software (Matlab & Simulink).

The final goal is to provide PhD students with the necessary background for starting research in the field of intelligent control relying on neural networks and fuzzy prototypes to be applied to autonomous systems.

Each lesson consists in lectures, numerical examples, simulation and analysis of case studies. |
| **Syllabus** | Classification of artificial neural networks. Neural network (NN) structures suitable for system modelling and control. NN learning algorithms. Application of NN in identification and modelling of complex systems. Selection of suitable NN structures and their validation. NN process model-based control structures. Application of NN for improvement of nonlinear control system performance. Concept of current NN linearization and its application to linear controller synthesis. Application of NN for compensation of system ambiguities. Basic of evolutionary and genetic optimization algorithms. Classification of fuzzy logic controllers. Methods for fuzzy controller design. Stability of fuzzy control systems. Methods for self-learning fuzzy controllers.

Motivating examples and case studies. |
| **Bibliography** | Recommended books:<br>[1] L.-X. Wang, "A course in fuzzy systems and control" - Prentice Hall, 1997<br>[2] D.T. Pham and X. Liu, "Neural Networks for Identification, Prediction, and Control" - Springer Verlag, 1995.

Slides and supporting material from lecturer. |

| Examination method | End-course examination based on a project work. |