Intelligent control of processes and factories

Academic Year: (2024 / 2025) **Review date: 21-10-2024**

Department assigned to the subject: Systems Engineering and Automation Department

Coordinating teacher: MORENO LORENTE, LUIS ENRIQUE

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 2

OBJECTIVES

BASICS COMPETENCES

CB6 Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context

CB7 That students know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study

CB8 That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments

CB9 That students know how to communicate their conclusions and the knowledge and ultimate reasons that sustain them to specialized and non-specialized audiences in a clear and unambiguous way

GENERALS COMPETENCES

CG1 Knowledge and understanding of the theoretical foundations of both industrial processes and services, and communications.

CG2 Ability to model, identify basic requirements and analyze various processes.

CG6 Capacity to adapt to changes in requirements associated with new products, new specifications and environments.

SPECIFIC COMPETENCES

CE1 Ability to design automatic process systems (production machinery, transport and storage systems and quality control) and the interconnection between their different modules (industrial protocols)

CE2 Ability to integrate and program the different industrial process control systems both from a hardware and software point of view

CE3 Ability to program and simulate robot control systems at high, intermediate and low levels

CE4 Ability to implement and simulate a system of intelligent and flexible control of processes and systems

LEARNING RESULTS

As a result of the learning, the student will be able to:

- Know the basics of automation of industrial systems and services (non-industrial): structure, industrial communications and systems control.
- Know the basics of collaborative robotics: structure, sensorization, control, programming, paths / outputs, multi- robot systems, industrial applications and services.
- Analyze and synthesize systems using advanced control: identification methods, fuzzy control, control with reference model, learning systems, control with neural networks, predictive control, etc.
- Use of simulation tools of production systems with continuous and discrete parts: lay-out, warehouses, transport, specific machines, delays, etc.
- Design an automated system of low and medium complexity with its cyber-physical components.

DESCRIPTION OF CONTENTS: PROGRAMME

Common themes of the subjects:
- Automatization and control of processes, plants and factories
- Structures of industrial plants and services according to CI 4.0 model
- Systems engineering and process integration
- Process and plants simulation tools

Specific themes of the subjects:

Intelligent control of processes and factories:
Control inteligente de procesos y factorías:
- Optimization: classical methods
- Evolutionary Algorithms: Genetic Algorithms, Differential Evolution and PSO.
- System Modeling : transfer function, state space model and complex system's modeling with Simulink/Matlab
- System's control PID/State feedback Control
- Observers and state estimators in presence of noise (Bayesian Filtering)
- Kalman filter, Extended Kalman Filter, Unscented Kalman Filter and Particle Filter
-LQR control and LQG Control

LEARNING ACTIVITIES AND METHODOLOGY

The activities carried out in the teaching of the subject are:

- Master classes. Presentation of the main concepts. Discussion and clarification of doubts about the concepts. We will work on transparencies that will be given to students to facilitate learning, in addition to a text or basic reference texts required in the course. Practical exercises, in the theory sessions problems will be posed and solutions will be discussed.
- Laboratories. Students (in teams of 2 or 3) will be offered practical case studies, must study them and then take the simulation data and analyze it. Knowledge of the topics covered in master classes and practical classes in the subject will be used. A preliminary study will be carried out, work will be carried out in the laboratory, and a written report will be delivered with the results and proposed solutions.

Addendum COVID-19:
Due to the situation caused by COVID-19, if necessary, both theory classes and practical exercises classes will be carried out online, the practices will be attempted in the laboratories, unless it is impossible, in which case they would also be adapted to do them. on line.

ASSESSMENT SYSTEM

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

The evaluation of the subject is based on the continuous evaluation model. The total of the student's grade will be derived from the evaluation of the different activities proposed in the course.
These activities may include:
- written problem solving and case studies
- carrying out individual or group laboratory practices
- carrying out self-learning tests,
. participation in online discussion forums, class attendance, etc.

The subject will be approved through continuous evaluation.

BASIC BIBLIOGRAPHY

- K. Ogata Modern Control Engineering, Prentice Hall.

- K. Ogata Discrete-time Control Systems , Prentice Hall.

- Nocedal, J. and S. J. Wright. Numerical Optimization, Second Edition, Springer Series in Operations Research, Springer Verlag, 2006

- Norma Nise Control Systems Engineering, Wiley, 2011

- Pintér, János D., ed. Global Optimization., Springer US, http://dx.doi.org/10.1007/0-387-30927-6., 2006

ADDITIONAL BIBLIOGRAPHY

- Chinchuluun, Altannar, Panos M. Pardalos, Rentsen Enkhbat, and E. N. Pistikopoulos, eds. Optimization, Simulation, and Control. , Springer New York. http://dx.doi.org/10.1007/978-1-4614-5131-0., 2013

- Randall L. Eubank. A Kalman Filter Primer., Chapman and Hall, 2006

- Schäffler, Stefan. Global Optimization, Springer New York. http://dx.doi.org/10.1007/978-1-4614-3927-1., 2012