60821 - Evaluation and control of production systems

Información del Plan Docente

Academic Year	2017/18
Subject	60821 - Evaluation and control of production systems
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	532 - Master's in Industrial Engineering
ECTS	6.0
Year	2
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. Its aim is to provide students with knowledge of modeling, analysis and control of concurrent discrete systems, whether distributed or not, applied to production systems. Production systems will be understood in a general purpose, studying their applications in four areas: manufacturing systems, logistic systems, workflows and path planning of mobile robots.

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A wide range of teaching and learning tasks are implemented, such as

- Lectures, where the theoretical and methodological concepts will be presented by using practical examples.
- Practice sessions, where different problems will be solved with the participation of students.
- Laboratory sessions, where students will work individually or in pairs to put into practice the concepts of interest, to implement control systems on real systems and to simulate using the computer evolution of systems.

5.2.Learning tasks

The course includes the following learning tasks:

- **T1 Lectures** (30 hours). Lecture sessions of theoretical and practical content illustrated with real examples. The concepts of digital control of continuous systems and modeling, analysis and control of discrete event systems. Student participation through questions and brief discussions is encouraged.
- **T2 Practice sessions** (15 hours). Problems and case studies with student participation, coordinated with the theoretical contents. Students are encouraged to work on the problems previously.
- **T3 Laboratory sessions** (15 hours). The student carries out the simulation, design and implementation of control systems on real systems. The sessions consist on a preliminary study done before the session and then a practical task completed in the laboratory.
- **T7 Autonomous work and study** (86 hours). Study of theoretical concepts and problem implementation. The ongoing work of the student is encouraged by the homogeneous distribution throughout the semester of the various learning activities. This includes tutorials for a direct follow-up of the student's progress, identification of learning problems, guidance on the course, help with exercises and doubts.
- **T8 Assessment exams** (4 hours). In addition to the grading function, they are also a learning tool with which the student checks the degree of understanding and assimilation acquired.

5.3.Syllabus

The course will address the following topics:

1. Introduction
2. Deterministic finite automata
3. Untimed Petri nets
4. Elements of linear programming and convex geometry
5. Production models in discrete time
6. Analysis of untimed (autonomous) Petri nets
7. Stochastic Petri nets and Markov chains
8. Performance evaluation: bounds
9. Performance evaluation: Approximations

Laboratory sessions

- Modeling and analysis with Place/Transition Petri nets
- Modeling and analysis with Colored Petri nets
- Path planning for multi-robot systems
- Performance Evaluation of manufacturing systems

5.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website (https://eina.unizar.es/) and (http://add.unizar.es)

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5.5.Bibliography and recommended resources

- Cassandras, Christos. Introduction to Discrete Event Systems / Cassandras, C.G. & S. Lafortune. Springer, 2008.
- Silva Suárez, Manuel. Las redes de Petri : en la automática y la informática / Manuel Silva . - 1a ed. 1985, 1a reimp. 2002 Madrid : Editorial AC, 2002
- T. Murata, "Petri nets: Properties, analysis and applications," in *Proceedings of the IEEE*, vol. 77, no. 4, pp. 541-580, Apr 1989.
- Girault, Claude, Valk, Rüdiger: "Petri Nets for Systems Engineering: A Guide to Modeling, Verification, and Applications", Springer-Verlag Berlin Heidelberg, 2003
- Kurt Jensen, Lars M. Kristensen: "Coloured Petri Nets Modelling and Validation of Concurrent Systems", Springer Berlin Heidelberg, 2009
- Manuel Silva, Enrique Teruel, José Manuel Colom: "Linear algebraic and linear programming techniques for the analysis of place/transition net systems", in Lectures on Petri Nets I: Basic Models, pp 309-373, 1998
- M. Ajmone Marsan, G. Balbo, G. Conte, S. Donatelli, G. Franceschinis: "Modelling with Generalized Stochastic Petri Nets," Wiley Series in Parallel Computing, John Wiley and Sons, 1995
- J. Campos, G. Chiola, J. Colom, M. Silva: "Properties and Performance Bounds for Timed Marked Graphs," IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications, vol. 39, no. 5, pp. 386-401, May 1992.