Course guide
205093 - 205093 - Cyberphysical System Scheduling

Last modified: 11/04/2025

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2025). (Optional subject).

Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Sarrate Estruch, Ramon

Others:

PRIOR SKILLS

Structured programming in C.
Digital feedback control.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CIA07. Analysis and design of critical response time systems.

TEACHING METHODOLOGY

In-person lectures provided through multimedia presentations
In-person laboratory sessions
Self-study, laboratory reports and homework

LEARNING OBJECTIVES OF THE SUBJECT

The course provide theoretical and practical content concerning cyber-physical systems scheduling.
The course focuses on programming and schedulability analysis of realtime multitasking systems.
Embedded supervisory and control applications will be developed under a realtime operating system.

STUDY LOAD

Type	Hours	Percentage
Hours large group	15,0	20.00
Hours small group	12,0	16.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

1. Introduction to cyber-physical systems

Description:
1.1. Introduction
1.2. Definition and features of cyber-physical systems

Full-or-part-time: 3h
Theory classes: 1h
Self study : 2h

2. Multitasking systems

Description:
2.1. Task scheduling
2.2. Task interaction

Full-or-part-time: 21h
Theory classes: 2h
Laboratory classes: 6h
Self study : 13h

3. Periodic and sporadic task scheduling

Description:
3.1. Static scheduling
3.2. Fixed priority scheduling
3.3. Dynamic priority scheduling

Full-or-part-time: 40h 30m
Theory classes: 8h 30m
Laboratory classes: 6h
Self study : 26h

4. Aperiodic task scheduling

Description:
4.1. Introduction
4.2. Jackson's algorithm
4.3. Horn's algorithm

Full-or-part-time: 4h 30m
Theory classes: 1h 30m
Self study : 3h

5. Hybrid task set scheduling

Description:
5.1. Introduction
5.2. Background scheduling
5.3. Aperiodic task servers

Full-or-part-time: 6h
Theory classes: 2h
Self study : 4h

ACTIVITIES

Lectures

Description:
Course content through multimedia presentations. The schedule is two hours per week.

Material:
Slides, uploaded to Atenea

Full-or-part-time: 12h
Theory classes: 12h

Laboratory

Description:
Students will work on personal computers and embedded systems for control, under a realtime operating system. Additionally, simulation tools will be used for schedulability analysis of ciber-physical systems. The schedule is two hours per week.

Full-or-part-time: 30h
Theory classes: 12h
Self study: 18h

Problems

Description:
Problems and exercices are proposed as homework.

Full-or-part-time: 3h
Self study: 3h

Final exam

Description:
A single exam is scheduled at the end of the course.

Full-or-part-time: 30h
Theory classes: 3h
Self study: 27h

GRADING SYSTEM

Lab reports: 55%
Problem assigments: 10%
Exam: 35%

BIBLIOGRAPHY

Basic:
- Buttazzo, Giorgio C. Hard real-time computing systems: predictable scheduling algorithms and applications [on line]. 3rd ed. New York: Springer, cop. 2011 [Consultation: 03/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3067230. ISBN 9781461406754.
- Liu, Jane W. S. Real-time systems. Upper Saddle River: Prentice Hall, cop. 2000. ISBN 9780130996510.
- Burns, Alan; Wellings, Andy. Sistemas de tiempo real y lenguajes de programación. 3ª ed. Madrid [etc.]: Addison Wesley, cop. 2003. ISBN 8478290583.

Complementary:
- Laplante, Phillip A. Real-time systems design and analysis: an engineer's handbook. 2nd ed. New York: Institute of Electrical and Electronics Engineers, cop. 1997. ISBN 0780334000.
- Burns, Alan; Davies, Geoff. Concurrent programming. Wokingham, England [etc.]: Addison-Wesley, cop. 1993. ISBN 0201544172.
- Buttazzo, Giorgio C. Soft real-time systems : predictability vs. efficiency. New York: Springer, 2005. ISBN 0387237011.