

# Course guide 205093 - 205093 - Cyber-Physical Systems Scheduling

Last modified: 02/04/2024

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).		

Academic year: 2024 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**

Туре	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. Introduction1.2. 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 scheduling2.2. 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. Introduction4.2. 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 Self study: 18h Theory classes: 12h

#### 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 Self study: 27h Theory classes: 3h



## **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=3067 230. 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.