



## Course guide

# 205204 - HPCAE - High Performance Computing for Aerospace Engineering

Last modified: 19/04/2023

**Unit in charge:** Terrassa School of Industrial, Aerospace and Audiovisual Engineering  
**Teaching unit:** 748 - FIS - Department of Physics.

**Degree:** BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).  
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).  
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

**Academic year:** 2023    **ECTS Credits:** 3.0    **Languages:** English

### LECTURER

**Coordinating lecturer:** Manel Soria

**Others:**

### PRIOR SKILLS

Good programming skills in C (preferably) or Fortran. Basic knowledge of interpreted languages such as Matlab or Python. Familiarity with Linux operating systems.

### TEACHING METHODOLOGY

The course will be developed through theoretical lectures and hands-on sessions where the students will implement fragments of high performance computing codes for aerospace applications, and study the practical behaviour of new and classic parallel computers.

### LEARNING OBJECTIVES OF THE SUBJECT

Understand the need of high performance computing for aerospace engineering applications.  
Understand the different computer architectures currently in use for high performance computing.  
Understand why only some algorithms can run in parallel.  
Understand the different parallel programming models.  
Acquire hands-on experience in parallel programming using OpenMP.  
Acquire hands-on experience in parallel programming using MPI.

### STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	40.00
Self study	45,0	60.00

**Total learning time:** 75 h



## CONTENTS

### Module 1: Introduction to high performance computing for aerospace engineering applications

**Description:**

- \* Motivations
- \* Limitations of the sequential processors
- \* Examples of problems in need of high performance computing
- \* Introduction to parallel computer architectures
- \* Shared memory model and distributed memory model

**Related activities:**

Case study one: parallel algorithms for image processing  
Case study two: genetic algorithms for optimization  
Case study three: interplanetary trajectory analysis

**Full-or-part-time:** 25h

Theory classes: 10h

Self study : 15h

### Module 2: OpenMP and MPI

**Description:**

- \* Description of the standards
- \* Hello world example

**Related activities:**

Hands on workshops: implementation, debugging and benchmarking

**Full-or-part-time:** 25h

Theory classes: 10h

Self study : 15h

### Module 3: Guided project

**Description:**

- \* The students will select the topic of their project in agreement with the professor.

**Full-or-part-time:** 25h

Theory classes: 10h

Self study : 15h

## GRADING SYSTEM

Class participation and class exercises: 30%

Assignment: 30%

Project: 40%

Students with a grade below 5.0 in the project, or the assignments, or the classroom participation, will be able to take an additional written exam covering all the subject, that will take place the date fixed in the calendar of final exams. The grade obtained in this test will range between 0 and 10, and will replace that of the part or parts below 5.0 only in case it is higher, up to a maximum of 5.0 points.