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# ENGINEERING PROGRAMME

2021-2022

2nd year / 3rd year

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## Specialisation option Scientific Challenge 2024

OD PARISCI

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PROGRAMME SUPERVISOR

Alban LEROYER



# 1st Semester

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Course unit	ECTS Credits	Track	Course code	Title
UE 73 / 93	12	Core course	ICS1 MANAPROJ MOD3D PROJET1 SIM3D	Scientific Computing 1 Project Management From geometry to 3D design Project 1 Numerical modelling
UE 74 / 94	13	Core course	ICS2 PROJET2	Scientific Computing 2 Project 2

# 2nd Semester

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Course unit	ECTS Credits	Track	Course code	Title
UE 103 / 83	14	Core course	PROJET3	Project 3

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 73 / 93

# Scientific Computing 1 [ICS1]

LEAD PROFESSOR(S): Alban LEROYER

### Objectives

The use of High Performance Computing technology requires to master some tools, concepts and technical skills which are addressed in this course, and then put into practice after. This module aims at providing basis to initiate an efficient self-training on the following items:

### Course contents

- Operation system GNU/Linux, Bash script : 2x2h (A.Leroyer)  
the goal to introduce this operating system generally poorly controlled by the students, yet indispensable in the HPC field (100% of HPC computers are operating with this family of operating systems).
- Specifications and UML : 2x2h (M. Servières)  
this introduction of software engineering aims at giving foundations of Unified Modeling Language, to design a software. After a presentation of the required elements in a software specification, the description of the different specification diagrams (use case, sequence, activity) is discussed before class diagrams, the core of UML, which is used to describe the structure of a software.
  - Agile/Scrum method : 2h (Pierre Auclair, common with INFO specialization)  
this speech scheduled with INFO specialization is also taken by students of the Scientific Challenges specialization. Taught by a visiting lecturer, Pierre Auclair, it aims at initiating students to agile methods well suited for software collaborative developments
  - Revision control system : 2x2h (A. Leroyer)  
Revision control systems are among the tools to master as soon as we are working on software development. This teaching sequence aims at introducing to the concept of distributed version control tools. The latter will be daily used in the further elaboration of the project.
  - Supercomputers and HPC : architecture, remote connexion, job submission : 2x2h (Pierre-Emmanuel Guérin, Hugues Dugonnet)  
This training aims at introducing students to the HPC world. Then, students would have a minimal background on HPC but also on the practical use of a supercomputer.
    - Programming paradigms, oriented object programming, Python: 4x2h (A. Leroyer), 2x2h (Myriam Servières)  
this part will ensure a better understanding about the different programming paradigms and the different types of programming languages. A focus on object oriented programming and Python language will be done afterwards.

Part of the work will be done as flipped classroom. A better involvement of the students is then expected in this field where the learning process requires practice.

Each student or students grouped by pair should prepare a training sequence (explanation and computer-based practical exercises) to the whole group on items which will be defined beforehand. This package will cover the prerequisites before starting efficiently to the appropriation of the SPRing code developed by the previous cohorts.

### Course material

### Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	2 hrs	28 hrs	0 hrs	0 hrs	2 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 73 / 93

# Project Management [MANAPROJ]

LEAD PROFESSOR(S): Thomas LECHEVALLIER

### Objectives

A project is a collective and individual adventure. The division of labor, the diversity of any team, the confrontation with changes and decisions make it necessary to put in place a balanced management and the experienced use of project management.

The objective of the course is to give:

- the tools essential for the drafting of each key deliverable in a project approach: opportunity analysis, pre-framing, Go / NoGO, framing, quality plan, progress monitoring, arbitration note, report, ..),
- the keys to project management (functions, habits, styles) in relation to the work of others, including change management and decision-making capacity while minimizing bias.

### Course contents

The learning will follow the standard chronology of a project, the practice will be based on the option projects on the first expected deliverables (Scoping).

### Course material

### Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 73 / 93

# From geometry to 3D design [MOD3D]

LEAD PROFESSOR(S): Alban LEROYER

### Objectives

The objective of this module is to provide the mathematical basis and the main techniques used in geometric object modeling, both for continuous representations (CAD) and discrete (mesh generation). A good knowledge of the different configurations of these objects in space is also part of this module.

### Course contents

- Mathematical description of parametric curves and surfaces as used by CAD software (4h)
- Surface and volume mesh generation methods (4h)
- parameterisation in space, and more specifically the specific case of orientation (2h)
- Introduction to 3D modeling software (2h)
- Introductory sessions on 3D Blender modeling and animation software (10h)

### Course material

### Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	12 hrs	10 hrs	0 hrs	0 hrs	2 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 73 / 93

### Project 1 [PROJET1]

*LEAD PROFESSOR(S): Alban LEROYER*

#### Objectives

The objectives of this first project phase are mainly the appropriation of content, understanding previous work and setting project objectives for the current year.

#### Course contents

#### Course material

#### Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	4	0 hrs	0 hrs	0 hrs	84 hrs	0 hrs



## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 73 / 93

# Numerical modelling [SIM3D]

*LEAD PROFESSOR(S): Alban LEROYER*

### Objectives

The objectives of this course is to introduce as a starting point what the numerical modelling covers: field of possibilities, limitations, pitfalls to avoid, skills to develop, cost, accuracy,...

The training will then highlight specific challenges related to the project, but which is also found in other fields such as Marine Renewable Energy or naval hydrodynamics in general

### Course contents

- Introduction to the numerical modelization ans simulation
- Numerical methods in Fluid Mechanics (CFD)
- Numerical problems for simulation of coupled problems, fluid-structure interaction.

### Course material

### Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	22 hrs	0 hrs	0 hrs	2 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 74 / 94

# Scientific Computing 2 [ICS2]

*LEAD PROFESSOR(S): Alban LEROYER*

### Objectives

This course aims at reinforce different notions related to scientific computing.

### Course contents

- Advanced use of revised control system: 2h  
-> this training aims at to check the practical use of Mercurial and to standardize the use within the group. This time will also be used to discuss more advanced fonctionnalités
- Advanced programming in Python: packaging, debugging, optimisation: 3x2h  
-> this teaching sequence aims at training students to debugging and profiling tools during a software development process.
- Parallel computing: 2x4h  
- these practical sessions will learn students about the different aspects of the parallelisation of a program.

### Course material

### Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	16 hrs	0 hrs	0 hrs	0 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 1st Semester - Course Unit 74 / 94

### Project 2 [PROJET2]

*LEAD PROFESSOR(S): Alban LEROYER*

#### Objectives

Once acquired skills and the master of tools delivered in the modules ICS1, MOD3D and SIM3D, and by relying on the task of acquiring during the module PROJET1, this part can give way to first studies and developments to apply and consolidate the knowledges and skills developed at the beginning of the semester.

#### Course contents

#### Course material

#### Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	11	0 hrs	0 hrs	0 hrs	196 hrs	0 hrs

## ENGINEERING - OD PARISCI

2nd year / 3rd year - 2nd Semester - Course Unit 103 / 83

### Project 3 [PROJET3]

LEAD PROFESSOR(S): Alban LEROYER

#### Objectives

This last part is the period when the students can take advantages in term of efficiency of their skills acquired in the scientific field and in project management too.

The completion of the deliverables, in the continuity of PROJECT2, operates at full capacity to be finished within the time limits. A time for drafting is also dedicated to provide high quality end-of-project documents but also transmit documents useful for the pursuit of the project. A time is also left to communication and to the presentation of the results.

#### Course contents

#### Course material

#### Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	14	0 hrs	0 hrs	0 hrs	196 hrs	0 hrs