




MSC MATHEMATICS AND APPLICATIONS PROGRAMME MATHEMATICS AND INTERACTIONS, MIX

IDENTITY CARD

- > Domain : Sciences, Technologies and Health
- > Full time course
- > [Continuing Education](#)

- > [120 ECTS credits](#)
- > 4 semesters
- >  La Rochelle

REGISTRATION

<https://www.univ-larochelle.fr/formation/admission-inscription-et-scolarite/candidatures-et-inscriptions/candidater-universite-la-rochelle/>

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OBJECTIVES

> Presentation



Do you wish to become an engineer knowing how to solve industrial problems with a mathematical approach ?

The Mathematics and interactions course from the MSc Mathematics and applications will allow you to know how to model and/or simulate concrete or theoretical situations, and to suggest efficient and reliable solutions by confronting them to numeric mathematics methods.

In order to clarify and solve problems, you will also learn how to manipulate, represent and restore usable data within an institution.



Michel Berthier

> At the end of this course, you will know

- > **Understand an engineering problem and identify the underlying mathematical problem**
 - o Analyze and translate an economic management problem into dynamic systems
 - o Combine mathematical tools with a concrete engineering problem
 - o Respect physical constraints in your mathematical approach
 - o Understand the qualities and shortcomings of a data set

➤ **Extract, process and analyze digital information from source data for the development of relevant models**

- Extract digital information from various acquisition protocols
- Process digital information from various acquisition protocols
- Analyze digital information and develop decision support tools

➤ **Develop and/or adapt mathematical models of natural processes to discrete and continuous scales**

- Implement modelling techniques and asymptotic study of random dynamics
- Rigorously scale a natural process model
- To concretely interpret and reinvest theoretical results of the geometry of the EDPs

➤ **Implement realistic simulations based on accurate, robust and fable mathematical tools**

- Choose a simulation algorithm according to the constraints
- Build and implement simulations of unstable processes
- Construct and implement signal analysis and process algorithms

➤ **Represent and visualize solutions, provide validated and usable answers**

- Master the foundations of theoretical analysis of partial differential equations
- Ensure the existence and criticize a weak solution based on physical constraints
- Use different visualization tools for the exploitation of results

➤ **Cross-curricular skills**

- Master the research, reading and writing of scientific documents in French and English
- Master computer tools for scientific calculation and numerical simulation
- Master computer tools for image processing and analysis

➤ **Pre-professional skills**

- Have a good knowledge of the potential of mathematics as an innovation language and as a creator of technological added value for industry
- Know how to take part and contribute to a collective project involving multidisciplinary skills
- Be rigorous and critical in formalising, modelling and solving a problem

✓ ADMISSION

➤ Your profile

You have a Bac+3, Bac+4 or equivalent (minimum 180 ECTS), and good knowledge in the field of mathematics

➤ How to apply ?

In the 1st year of the Master's degree, the selection of candidates is made on the basis of their application documents.

How to apply to the [1st year of the Master's](#)

How to apply to the [2nd year of the Master's](#)

📄 PROGRAMME

● Mandatory ■ Course option

➤ Semester 1

➤ Acquisition and simulation ●

Learning Outcomes

Extract digital information from various acquisition protocols

Choose a simulation algorithm according to the constraints

- Image acquisition

Learning outcomes

The aims of this course are :

- to know the main characteristics of various acquisition protocols ;
- to be able to extract digital information from these protocols.

Language used for teaching

French

Teaching time

30h (9h lectures - 21h practical work)

3 ECTS credits

Course code

C6-259142-MATH

- Numerical simulation by finite elements

Learning outcomes

The aims of this course are :

- to know how to implement simple finite element simulation algorithms ;
- to be able to discuss the choice of a simulation algorithm according to the constraints.

Language used for teaching

French

Teaching time

32h (9h lectures - 18h practical work - 5h work in accompaniment)

3 ECTS credits

Course code

C6-259141-MATH

> Cross-curricular courses ●

- Communication

Language used for teaching

French

Teaching time

12h (6h lectures - 6h practical work)

1 ECTS credit

Course code

C6-259102-PROF

- First Foreign Language: English

Language used for teaching

French

Teaching time

24h (24h tutorials)

2 ECTS credits

Course code

DC-259101-ANG

- Writing scientific documents

Language used for teaching

French

Teaching time

15h (15h practical work)

2 ECTS credits

Course code

C6-259103-MATH

> Dynamics ●

Learning Outcomes

- Analyze and translate an economic management problem into dynamic systems
- Implement modelling techniques and asymptotic study of random dynamics

- From the scale of particles to the scale of observation

Learning outcomes

The aims of this course are :

- to know how to implement modelling and asymptotic study techniques of a random dynamic ;
- to be able to simulate processes.

Language used for teaching

French

Teaching time

39h (15h lectures - 12h tutorials - 12h practical work)

3 ECTS credits

Course code

C6-259111-MATH

- Temporal dynamics

Learning outcomes

The aims of this course are :

- to know how to implement modelling and asymptotic study techniques to a temporal dynamic ;
- to be able to translate and analyze a resource optimization problem in terms of dynamic systems.

Language used for teaching

French

Teaching time

24h (12h lectures - 12h tutorials)

3 ECTS credits

Course code

C6-259112-MATH

> Implementation •

Learning Outcomes

Combine mathematical tools with a concrete engineering problem

- Junior seminars

Learning outcomes

The aims of this course are :

- to have a good knowledge of the potential of mathematics as an innovation language and as a creator of technological added value for industry ;
- to have a good knowledge of the challenges of current mathematical research.

Language used for teaching

French

Teaching time

24h (24h work in accompaniment)

2 ECTS credits

Course code

C6-259131-MATH

- Math Enterprise Week

Learning outcomes

The aims of this course are :

- to be able to understand a problem in terms of engineering and identify the underlying mathematical problem ;
- to be able to reinvest your knowledge to propose solutions ;
- to know how to take part and contribute to a collective project involving multidisciplinary skills.

Language used for teaching

French

Teaching time

26h (26h work in accompaniment)

2 ECTS credits

Course code

C6-259133-MATH

- Tools for calculation

Learning outcomes

The aims of this course are :

- to be able to produce and implement simple algorithms for resolution or simulation ;
- to master modern program sharing tools.

Language used for teaching

French

Teaching time

21h (21h practical work)

2 ECTS credits

Course code

C6-259132-MATH

> Partial differential equations ●

Learning Outcomes

Master the foundations of theoretical analysis of partial differential equations

Ensure the existence and criticize a weak solution based on physical constraints

- Assisting autonomy

Learning outcomes

The aims of this course are :

- to know how to apprehend a problem and how to deal with it ;
- to be rigorous and critical in formalizing, modeling and solving a problem.

Language used for teaching

French

Teaching time

28h (8h tutorials - 20h work in accompaniment)

2 ECTS credits

Course code

C6-259122-ODP

- Partial differential equations

Learning outcomes

The aims of this course are :

- to master the foundations of theoretical analysis of partial differential equations ;
- to have a good knowledge of the essential results of the fundamental models ;
- to know how to implement the study of a physical model in PDE.

Language used for teaching

French

Teaching time

58h 30min (22h 30min lectures - 36h tutorials)

5 ECTS credits

Course code

C6-259121-MATH

> Semester 2

> Acquisiton and simulation ●

Learning Outcomes

Process digital information from various acquisition protocols

Choose a simulation algorithm according to the constraints

- Image data processing

Learning outcomes

The aims of this course are :

- to be able to implement processing, segmentation and detection algorithms ;
- to know how to develop descriptors for the extraction of statistical characteristics.

Language used for teaching

French

Teaching time

43h (9h lectures - 30h practical work - 4h work in accompaniment)

3 ECTS credits

Course code

C6-259242-MATH

- Simulation, which solution for which problem?

Learning outcomes

The aims of this course are :

- to be able to characterize the theoretical error of numerical reference schemes ;
- to be able to provide visualizations of the error on realistic non-trivial examples.

Language used for teaching

French

Teaching time

33h (9h lectures - 24h practical work)

3 ECTS credits

Course code

C6-259241-MATH

> Cross-curricular courses ●

- First Foreign Language: English

Language used for teaching

French

Teaching time

24h (24h tutorials)

2 ECTS credits

Course code

DC-259201-ANG

- Gestion des entreprises

Language used for teaching

French

Teaching time

9h (4h 30min lectures - 4h 30min tutorials)

1 ECTS credit

Course code

C6-259202-GEST

> From the scale of particles to the scale of observation ●

Learning Outcomes

Rigorously scale a natural process model

- Assisting autonomy

Learning outcomes

The aims of this course are :

- to know how to apprehend a problem and how to deal with it ;
- to be rigorous and critical in formalizing, modeling and solving a problem.

Language used for teaching

French

Teaching time

15h (15h work in accompaniment)

1 ECTS credit

Course code

C6-259212-ODP

- Random dynamics

Learning outcomes

The aims of this course are :

- to be able to rigorously scale a natural process model ;
- to control microscopic-mesoscopic-macroscopic scale changes ;
- to know how to approach a problem in a unified way at different scales.

Language used for teaching

French

Teaching time

44h (12h lectures - 12h tutorials - 15h practical work - 5h work in accompaniment)

4 ECTS credits

Course code

C6-259211-MATH

> Implementation ●

Learning Outcomes

Combine mathematical tools with a concrete engineering problem

- Physics of materials

Learning outcomes

The aims of this course are :

- to possess basic knowledge of the structure of materials ;
- to be familiar with the various material imaging protocols.

Language used for teaching

French

Teaching time

18h (6h lectures - 9h tutorials - 3h practical work)

2 ECTS credits

Course code

C6-259232-MATH

- Junior seminars

Learning outcomes

The aims of these seminars are :

- to acquire a good knowledge of the potential of mathematics as an innovation language and as a creator of technological added value for industry ;
- to become knowledgeable about challenges of current mathematical research.

Language used for teaching

French

Teaching time

16h (16h work in accompaniment)

1 ECTS credit

Course code

C6-259231-MATH

- Math Enterprise Week

Learning outcomes

The aims of this course are :

- to be able to understand a problem in terms of engineering and identify the underlying mathematical problem ;
- to be able to reinvest your knowledge to propose solutions ;
- to know how to take part and contribute to a collective project involving multidisciplinary skills.

Language used for teaching

French

Teaching time

34h (34h work in accompaniment)

2 ECTS credits

Course code

C6-259233-MATH

> Internship ●

- Internship (8 weeks)

Language used for teaching

French

5 ECTS credits

Course code

C6-259203-STAG

> PDE: physical solution vs. mathematical solutions •

Learning Outcomes

Respect physical constraints in your mathematical approach

- Assisting autonomy

Learning outcomes

The aims of this course are :

- to know how to apprehend a problem and how to deal with it :
- to be rigorous and critical in formalizing, modeling and solving a problem.

Language used for teaching

French

Teaching time

20h (20h work in accompaniment)

2 ECTS credits

Course code

C6-259222-ODP

- PDE: physical solution vs. mathematical solutions

Learning outcomes

The aims of this course are :

- to know how to respect physical constraints in his mathematical approach ;
- to be able to prove the existence and criticize a weak solution based on physical constraints.

Language used for teaching

French

Teaching time

39h (15h lectures - 12h tutorials - 12h work in accompaniment)

4 ECTS credits

Course code

C6-259221-MATH

> Semester 3

> Frequency processing and analysis •

Learning Outcomes

Construct and implement signal analysis and process algorithms

- Signal and image

Learning outcomes

The aims of this course :

- to master modern signal processing and analysis tools (frequency and multi-resolution analysis) ;
- to construct and implement signal analysis and processing algorithms.

Language used for teaching

French

Teaching time

56h (12h lectures - 24h tutorials - 15h practical work - 5h work in accompaniment)

5 ECTS credits

Course code

C6-259341-MATH

- The handled signal

Learning outcomes

The aims of this course are :

- to develop good knowledge of various applications of theory to sound, image and video ;
- to be able to implement playful demonstrators.

Language used for teaching

French

Teaching time

15h (15h work in accompaniment)

1 ECTS credit

Course code

C6-259342-MATH

> PDE geometry ●

Learning Outcomes

To concretely interpret and reinvest theoretical results of the geometry of the EDPs

- Assisting autonomy

Learning outcomes

The aims of this course are :

- to know how to apprehend a problem and how to deal with it ;
- to be rigorous and critical in formalizing, modeling and solving a problem.

Language used for teaching

French

Teaching time

18h 30min (4h 30min tutorials - 14h work in accompaniment)

2 ECTS credits

Course code

C6-259332-ODP

- PDE geometry

Learning outcomes

The aims of this course are :

- to be able to justify the contribution of an abstract approach that takes advantage of problem-based geometry ;
- to master the basic tools of Riemannian geometry related to the study of PDDs on manifolds.

Language used for teaching

French

Teaching time

45h (24h lectures - 21h tutorials)

4 ECTS credits

Course code

C6-259331-MATH

> Cross-curricular courses ●

- What are the issues at stake for mathematics in R&D?

Language used for teaching

French

Teaching time

10h 30min (10h 30min tutorials)

1 ECTS credit

Course code

C6-259302-RECH

- Writing and publishing scientific documents

Language used for teaching

French

Teaching time

15h (15h practical work)

2 ECTS credits

Course code

C6-259301-ODP

> Data analysis •

Learning Outcomes

- Analyze digital information and develop decision support tools
- Use different visualization tools for the exploitation of results

• Data analysis and graphical models

Learning outcomes

The aims of this course are :

- to be able to structure and describe the statistical characteristics of a data set ;
- to analyze digital information and develop classification and decision-making tools.

Language used for teaching

French

Teaching time

64h (18h lectures - 26h tutorials - 20h practical work)

5 ECTS credits

Course code

C6-259321-MATH

• Visualization

Learning outcomes

The aims of this course are :

- to be able to use a visual representation from a graphical interface to understand a problem ;
- to know how to choose and use relevant representations for the exploitation of results.

Language used for teaching

French

Teaching time

24h (3h lectures - 15h tutorials - 6h work in accompaniment)

2 ECTS credits

Course code

C6-259322-MATH

> Foreign language •

• First Foreign Language: English

Language used for teaching

French

Teaching time

24h (24h tutorials)

2 ECTS credits

Course code

DC-259351-ANG

> Simulation and reality •

Learning Outcomes

- Understand the qualities and shortcomings of a data set
- Build and implement simulations of unstable processes

• Transfer and materials

Learning outcomes

The aims of this course are :

- to have a basic knowledge of the complexity of transfer dynamics in materials ;
- to know how to mathematically model the main transfer phenomena in materials.

Language used for teaching

French

Teaching time

24h (9h lectures - 15h practical work)

2 ECTS credits

Course code

C6-259312-MATH

- Numerical simulation for hydrodynamics

Learning outcomes

The aims of this course are :

- to be able to develop, analyze and implement algorithms dedicated to the simulation of hydrodynamic systems ;
- to be able to develop, analyze and implement variational methods for assimilating hydrodynamic data.

Language used for teaching

French

Teaching time

56h (15h lectures - 15h tutorials - 26h practical work)

4 ECTS credits

Course code

C6-259311-MATH

> Semester 4

> Cross-curricular courses •

- Internship (18 weeks)

Language used for teaching

French

30 ECTS credits

Course code

C6-259401-STAG

AFTERWARDS

> Further Education

- [PhD](#)

> Professions

- Design and research engineer (R&D) ;
- Engineer and manager of production and control methods ;

Information subject to change

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