

Track MAGIS
Track microfluidics

GENERAL PRESENTATION

Master Material Science and Engineering – Université Paris Sciences et Lettres

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The Master in Materials Science and Engineering (MSE) from Université PSL provides the experimental and theoretical knowledge required to **conceive and design the materials** of tomorrow and to **improve the performance** of existing materials and predict their lifespan. **Co-sponsored by Chimie ParisTech, MINES ParisTech and ESPCI Paris**, this program aims to establish a link between the processes of development, synthesis and layout, (micro) structures and structural and/or functional properties of various materials such as polymers, metal alloys, ceramics and biomaterials.

The first year of the Master in Materials Science and Engineering is common to the three tracks offered for the second year:

- Track “Materials for the Future: Design and Engineering” – taught in French
- Track “Materials and Engineering Sciences in Paris” – fully taught in English or in French
- Track “Microfluidics” – taught in English

The Master in Materials Science and Engineering aims at training **high-level scientists** with an integrative view of materials and their functionalities all along their life cycle. The experimental approach is favored with more than 150 hours of experimental work during the two years of the master’s program and at least 32 weeks of internship either in the academic field or in high-technology industries.

Who should apply ?

Master 1

Bachelor of Science degree in Chemistry, Physical Chemistry, Mechanics (equivalent to 180 ECTS).

Master 2

Students who have:

- completed a M1 year in science,
- successfully completed their 2nd year of engineering school.

Students with a Bachelor of Science degree might be also accepted.

Job opportunities

- PhD in one of the doctoral schools (DS) of PSL (DS Systems Engineering, Materials, Mechanics, Energetics; DS Physics and chemistry of materials, DS Physical and analytical chemistry), elsewhere in France or abroad;
- High-technology industries (transports, aircraft, biotechnologies, chemistry, optics...)
- PSL-ITI (Institute of Technology and Innovation) program : The purpose of this research-based program is to train a new generation of exceptionally high-level engineers, researchers, PhDs and entrepreneurs who are open to multidisciplinary study, innovation and entrepreneurship.
- Advanced Master’s degree (for example: Design of Materials and structures from MINES ParisTech, etc)

CURRICULUM

Master 2 : Track « Materials and Engineering Sciences in Paris » – MAGIS

The objectives of this program are to provide students with a deeper understanding of materials science & engineering and solid mechanics fundamentals and to impart a better knowledge of recent developments in the field, for advanced industrial applications and innovative processes. This track provides an education in the mechanics of materials. It focuses on the relationships between processes, materials, microstructures, and mechanical properties for advanced industrial applications and innovative processes.

The track « MAGIS » is divided into core courses and the choice of one option to choose among 4 :

- Option 1 (Op1) : Damage and fracture of materials and structure
- Option 2 (Op2) : Metal and alloy processing, advanced methods and innovative processes
- Option 3 (Op3) : Polymers and composites life-cycle
- Option 4 (Op4) : Innovative cutting processes and smart machining

This track is proposed in partnership with the University Paris Saclay and Arts & Métiers ParisTech.

Semester 3		ECTS	Op1	Op2	Op3	Op4
EQUALIZATION TEACHING UNITS (not mandatory, 0 ECTS)	30 h	0				
CORE COURSES	150 h	18				
<i>Material Sciences</i>	30 h	3				
<i>Materials constitutive equations</i>	30 h	3				
<i>Numerical methods for continuum mechanics</i>	30 h	3				
<i>Méthodes expérimentales et identification de champs</i>	30 h	3				
<i>Advanced experimental methods</i>		3				
<i>Research project</i>		3				
OPTION (3 mandatory units + 1 unit to be choosen)	120 h	12				
<i>Fracture mechanics</i>	30 h	3	O			
<i>Mechanics of materials under impact loading</i>	30 h	3	O		X	
<i>Continuum damage mechanics</i>	30 h	3	O	X		X
<i>Heterogeneous media : large scale behaviours</i>	30 h	3	X	X	X	X
<i>Polymers processing</i>	30 h	3	X	X	O	X
<i>Algorithmic modelling of multiphysics processes</i>	30 h	3	X	X	X	X
<i>Solid metal processing</i>	30 h	3	X	O	X	O
<i>Fatigue of materials : mechanisms and modelling</i>	30 h	3	X	X	X	X
<i>Fluid metal processing</i>	30 h	3		O		18
<i>Metal processing, modelling and numerical processing</i>	40 h	3		O		
<i>Durability of polymers</i>	30 h	3			O	
<i>Behaviour of polymers</i>	30 h	3			O	
<i>Thermomechanical aspects and simulation</i>	30 h	3				O
<i>Dynamics and experimentation</i>	30 h	3				O
Total du S3	300 h	30				
Semester 4	Internship (minimum 5 months) 30 ECTS *	30				
Total du M2	300 h	60				

O : mandatory teaching unit for the given option

X : optional teaching unit for the given option

Master 2 : Track « Microfluidics »

The objective of the track “Microfluidics” is to prepare students for new career opportunities, not only in the field of microfluidics but also in any area involving fluids and micro/nanotechnologies.

This is why the training is very open-ended: fluid dynamics, physical chemistry, opening to biology, biotechnology, and many practicals in micro/nanofabrication. The courses are provided by leading professors, experts in their field, opened to academic research at the highest level and offer an attractive profile for many companies involved in these matters.

The number of areas of interest in microfluidics (either academic or industrial ones) is considerable: medicine, energy, green chemistry, cosmetics, food industry... Tomorrow, the technologies currently developed will allow:

- In BIOLOGY: to process a large number of samples, conduct experiments on the scale of the cell and understand the interactions between cells, improve the accuracy and timeliness of diagnosis as HIV, reduce experimental volumes...
- EN CHEMISTRY: to test thousands of reactions, encapsulate chemical reactions in microfluidic drops...
- EN PHYSICS: to create controlled automated systems and experimental set-ups...

Thus, this track opens to great opportunities in a new field, with strong international growth in a multidisciplinary spirit, yet avoiding a premature specialization.

This track is proposed in partnership with Sorbonne University, the University Paris Saclay and the University Paris Diderot.

Semester 3
EQUALIZATION TEACHING UNITS in physics, chemistry and biology
CORE COURSES
Micro- et nanofabrication techniques
Surface functionalization with molecules and biomolecules
Characterization techniques
Hydrodynamics et transport at the micro and nanofluidic scale
Capillarity and wetting phenomena, soft matter, physics of interfaces
Bioassays, analytical devices
Continuous flow and segmented flow chemistry
Organs on chips
Behavior of individual and collective celled in and on microfabricated devices
Droplet-based biochemistry and single cell analysis
ADVANCED COURSES (2 units to be chosen)
Advanced hydrodynamics and nanofluidics
Advanced statistical mechanics
Advanced flow chemistry
Analytical chemistry
Physics and measurements
Synthetic biology
Medical imaging
Statistics and data science
Biophysics
Machine learning
Semester 4 Internship
UE 5-months internship

PRACTICAL INFORMATION

Institution for registration

Chimie ParisTech
11 rue Pierre et Marie Curie
75005 PARIS
www.chimie-paristech.fr

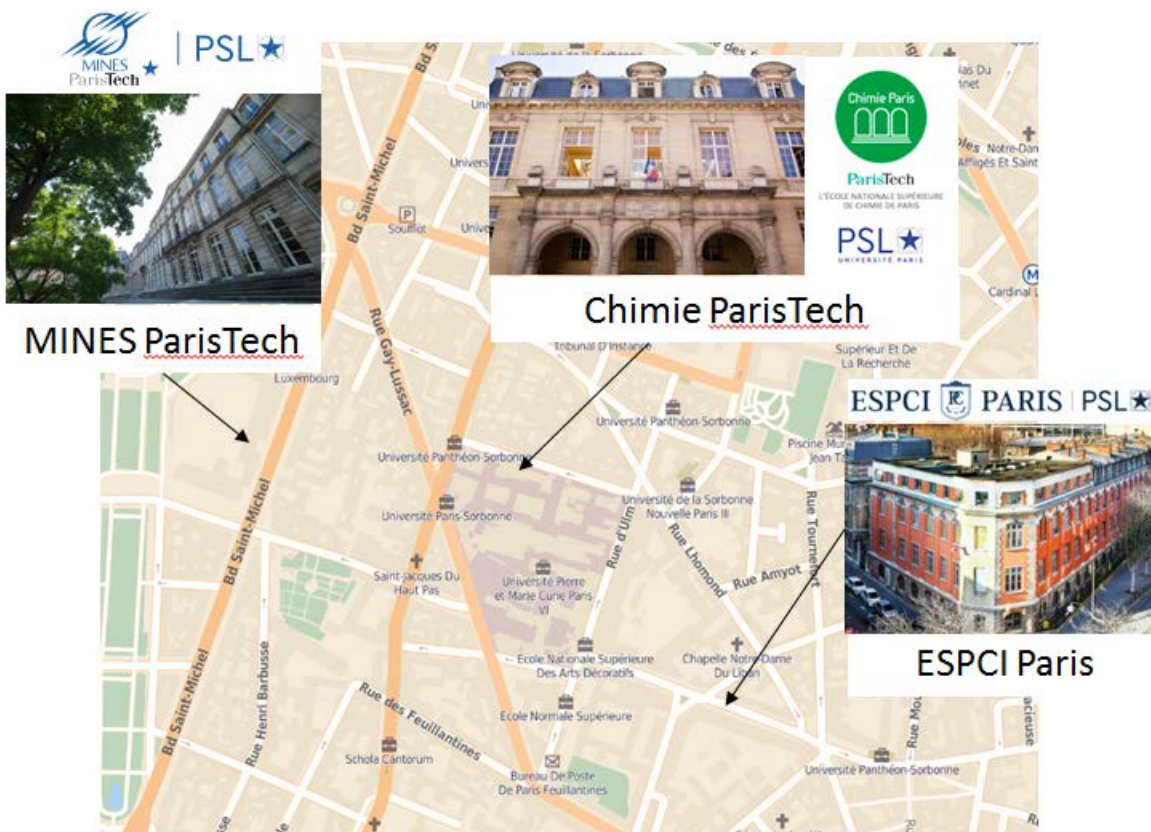
Teaching institutions

Most of the courses are held in three partner institutions of this master's program! Chimie ParisTech, MINES ParisTech, ESPCI Paris.

MINES ParisTech
60 boulevard Saint-Michel
75006 Paris
www.mines-paristech.fr

ESPCI Paris
10 rue Vauquelin
75005 PARIS
www.espci.fr

All these institutions are located in the center of Paris.



For the track MAGIS, some teachings will occur at Arts & Métiers ParisTech - Boulevard de l'Hôpital (Paris 13^e arrondissement) and at the University Paris Saclay (1 day / week).

Contacts

Master in Material Science and Engineering :

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<https://www.psl.eu/formation/master-sciences-et-genie-des-materiaux>

Track MADI : Domitille Giaume, Cécilie Duhamel, Corinne Soulié, Cécile Monteux

Track MAGIS : Thilo Morgeneyer

Track microfluidics : Jacques Fattaccioli

<https://microfluidics-master.fr/>

Welcome Desk PSL : welcomedesk@psl.eu / 01 75 00 02 91

The Welcome Desk helps international students for administrative procedures and boosts up their everyday life.

A bilingual team organizes different activities throughout the year. Touristic joggings, cultural visits...there is something for everyone! At these events international students meet other students, both internationals and Parisians who are part of the PSL network, improve their French and discover the different parts of Paris.

For more information, Facebook page: Welcome to Paris and to PSL!