Chimie ParisTech – Université PSL

Fostering talents for tomorrow’s chemistry

Chimie ParisTech general presentation
Chemistry at the heart of Paris

1896: Founded by Charles Friedel

1899-1907: Directed by Henri Moissan (Nobel Prize winner 1906)

1916: First woman embracing engineer career in France

1904: Eugène Schueller, founder of L’ORÉAL

« Young chemists devoted to industrial careers should have a scientific background as solid as that of those embracing purely academic ones »
Paris and its region

- 816 000 businesses
- 1/3 of the foreign businesses in France
- 1st European center for Fortune 500 multinational companies
  - 1st European center for professional meetings
  - 30% of France’s Gross Domestic Product (GDP)
- Paris among World’s Best Student City (QS)
  - 17 Universities, 40 Graduate Schools of Engineering
  - > 70 000 foreign students (20% of the students of the area)
- 1st European region in R&D
  - 40% of national investment in research and development
  - 95 500 researchers
Chimie ParisTech belongs to a world class University

- 4th University younger than 50-year-old (QS, THE)
- Ranked in the top 50 worldwide (QS, THE)
- 1st University among Millennials (THE)
University PSL in a nutshell

- 17,000 students
- 4,500 researchers
- 181 labs
- 91 libraries and museums

- 50 startups founded
- ~ 70 patents/year
- 2,500 business partnerships

- 50 César prize
- 79 Molière prize
- 2 Olympic games medals

- 27 Nobel
- 10 Fields Medal
- 3 Abel prize
- 48 CNRS Gold medal

150 ERC since 2011
ParisTech – Alliance of graduates schools in engineering

- An exceptional union enabling a unique transdisciplinarity network
- Each School is ranked #1 at the national level in its specific domain

Our shared-values

**Excellence** based on the model of French “Grandes Écoles”

**Openness** as a driver for growth: international openness, social diversity, openness to new pedagogical methods

The quest for innovation, key to future successes for our Schools
Our Vision

Provide basics & fundamentals courses in all fields of chemistry illustrated by a cutting-edge research
Training

Highly selected students (50% of women): 350
140 Researchers and Professors & Associate Professors
20% international students
100% abroad

1 Prof for 3 students
40% Practical training
20% Business, management and human skills

Mandatory internship 12 months
Researchers and Professors & Associate Professors

140

PhD and post-docs

140

Research Teams

13

Research Chimie ParisTech general presentation

7 per week

Laboratories

3

100%

Label

cnrS

erc

4
Research & Development

Chair
With Eco-Systèmes

1

50% of PhD funded by companies

2 Labcom
(joint lab with SMEs)

>40

Research contracts per year
Chimie Paris Innov

Chimie Paris Innov our incubator cofunded by the European Union
➢ 700 000€ project
➢ Started in 2018

Augmented Wood, and next generation of Human-to-Machine Interfaces

Plasma catalysis technology for methanation of CO₂
European patent [EP15202925.2] 2015

ENERGO, Ferroscan, LOMA, KOYA...

Zinc-Air
Cheap and Safe Batteries for Electrical Vehicles & Stationary Electricity Storage
Paris FLOW Tech

Continuous Flow Chemistry Technology Platform

- All activations in one place
- Unique in Europe
- 1.7M€ project
- Business need driven
Institut Carnot

The Carnot network
• 39 Carnot Institutes in France
• Given by the French Ministry of Higher Education, Research & Innovation
• Ambition to foster public/private partnerships

Institut Carnot IPGG Microfluidique represents:
• 350 researchers
• Common theme: flow at tiny scale and its many applications (milli-micro-nano-fluidics)
• Member institutions: Chimie ParisTech, ENS, ESPCI, PSL, CNRS
• Sectors
  ✓ Chemistry ✓ Energy
  ✓ Pharmaceuticals ✓ Environment
  ✓ Life sciences ✓ Luxury goods
Employability of our Engineers

+ 90% of the students get a job or PhD before the graduation ceremony

Class 2018 (110 students)
RESEARCH

A world class research made to tackle global societal challenges
Our 3 research joint laboratories with CNRS

Paris Research Institute of Chemistry Materials & Energies

Institute of Chemistry for Life Sciences & Health

Ile-de-France Institute for photovoltaic
Our main research areas

Chemistry for Materials & Energies

• Materials Sciences
• Thin Films and Surfaces
• Chemical Engineering
• Organometallic Chemistry
• Polymerization Catalysis
• Energy
• Microsystems
• Heritage materials
• Nano materials & structures
• Modelisation

Chemistry for Life Sciences & Health

• Analytical physico-chemistry : (electrochemistry, separative methods & coupling of detection techniques)
• Miniaturization
• Imagery
• Organic synthesis and methods for imaging and screening
• Modeling & theoretical Chemistry
• Inorganic Biological Chemistry, Medicinal Inorganic Chemistry, Medicinal Organometallic Chemistry
• Catalysis, Synthesis of Biomolecules and Sustainable Development
Selected examples of our research

✓ Imaging and characterization
✓ Nano and smart materials
✓ Catalysis
✓ Chemical Engineering and flow chemistry
✓ Modeling and simulation
Imaging and characterization

Design of new materials for Imaging and Biophotonic:
Focus on materials design, optical spectroscopy and mechanisms: Oxides and fluorides based nanomaterials used as nanosensors for thermal imaging at nanoscale, cell imaging and in-vivo bio-imaging.

Development of new bio imaging techniques
Methodological development of bimodal and multi-parametric imaging in MRI and optical contrast agents

Electrochemical microscopy for 3D Morphology and cartography of real time reactivity of biological systems
Characterization and imaging

Characterization of surfaces
Surface spectroscopies and microscopies:
X-Ray photoelectron spectroscopy (XPS),
time-of-flight secondary ion mass spectrometry (ToF-SIMS),
scanning probe microscopes (STM, AFM).

Structural Metallurgy
Investigation of microstructures/mechanical properties relationships using advanced characterization methods ("in situ" mechanical testing, EBSD, TEM, high energy synchrotron X-rays diffraction)
Ancient & Heritage materials

- Authentification and conservation of cultural heritage artifacts

Analytical techniques
- Ion Beam Analysis, X-Ray Fluorescence, Electron Magnetic Resonance, SEM-FEG-EDS,
- X-Ray Diffraction & Structure Analysis, Raman & UV/Vis/IR Spectroscopy,
- multi-spectral imaging, BET Surface Desorption
Nano & smart materials

Nanostructured Materials for photovoltaics & optoelectronics
Hybrid solar cells (perovskite/dye sensitized/Quantum Dot)

Crystals and Quantum State Dynamics: Control of non-classical optical & spin states in rare earth doped single crystals & nanoscale systems.


Smart Polymers
Self-assemblies: amphiphilic copolymers & liquid crystal polymers
Polymer nanoparticles for drug delivery and bioimaging: fluorescent self-assemblies with aggregation induced emission

Nanoparticles for Biomedical diagnostic & therapy
Catalysis

Monomers from renewable sources and **renewable monomers**

Organometallic catalysts for **stereoselective polymerization**

Control and synthesis of polymer based nano-objects

Catalysts for **tandem catalysis**

**Catalysis & Metal-Organocatalysis**
step and atom-economical processes; solventless reactions, chemistry in water; Fe, Ru, Rh, Pt, Cu, In, Pd-catalyzed reactions for C-H, C-C & C-N bond formation; asymmetric reduction

**Total Synthesis of Biomolecules**
Chemical engineering and flow chemistry

- Deposition of coatings by innovative plasmas Processes
- Plasma Processes for depollution & recycling
- CO₂ methanisation by plasma assisted catalyst
- Flow chemistry for Functionalisation and Synthesis of molecules and polymers
Modeling and theory

Development of new methods (electronic structure, environment): DFT approaches, embedding models, solvent models; Implementation in largely distributed codes

Modelling and design molecule based devices: photovoltaics, AIE, light activated devices

Properties of biologically relevant molecules: Photo Dynamic Therapy, 2 Photons Absorption, DNA intercalators…

Modeling of surfaces and materials: reactivity, properties

Modeling of soft and porous materials

Modelling of catalytic reaction mechanisms and optimization (homogeneous & heterogeneous)
Excellent facilities for research within Paris

- NMR / Microscopy and spectroscopy...
- New AGLAE @ Musée du Louvre
Pierre Gilles de Gennes Institute for microfluidics

- National excellence laboratory
- Created in 2011
- € 28.2M project
- To bring together, in a cross-disciplinary domain, experts from various disciplines (Physics, biology, chemistry, technology)
- To develop both basic and applied research

www.institut-pgg.com
Training top level professionals in chemistry

Year 1
Towards engineering
Basic courses
Team projects
Management, Economy
Language and Cultures
Work internship 1-2 months

Year 2
Options
Basic courses & options
Projects (innovation)
Management, Economy
Language
Internship - 5 months

Year 3
Specialization
Projects (entrepreneurship)
Engineering or Research master
Master internship - 6 months

- 12 months of mandatory internship
- Regular meetings with industrials (conferences, workshops, visits)

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Training top level professionals in chemistry

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Organic and Bioorganic Chemistry
Solid State Chemistry
Material Science
Analytical Chemistry
Chemical and Process Engineering
Environmental science
Theoretical Chemistry
Life and health sciences
Nuclear Chemistry

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First year: high level scientific skills

1 Sept-31 Dec

Courses
Chemical engineering, Risks, Physicochemistry, analytical, organic chemistry I, Mathematics, quantum mechanics, Computing and programming, Management economy

1 Jan-30 Apr

Courses
Organic chemistry, Quantum chemistry, spectroscopy, Crystallography, solid state chemistry, organic chemistry II, Numerical methods

1 May-30 Jul

Lab project
team work in a lab

Work internship
(1 or 2 months)

Transdisciplinary project
team work on social, economical or environmental issues
Second year: New applications

1 Sept-31 Dec
Common bases
Chemical engineering, Metallurgy, Polymers, Analytical chemistry II, Biochemistry, Nuclear energy and radioactivity, Thermostatistics and modelization, Inorganic chemistry

1 Jan-30 Mar
Options
Molecular chemistry Materials
Chemical engineering Analytical and Biological Chemistry Biotechnologies
Techno Team project (1/2 day per week) teamwork Building of a prototype

1 Apr-30 Aug
Internship (4-5 months)
Third year: specialization industrial innovation and/or research

1 Sept - 31 Jan

Engineering
- Biotechnologies
- Sustainable processes & materials
- Industrial processing
- Green organic chemistry
- Cosmetology and Formulation
- Energies

1 Feb - 31 Jul

Internship
(6 months)
Masters @ Chimie ParisTech

• Master in Chemistry with

• 5 tracks
  • Molecular Chemistry (FR)
  • Chemistry of Materials (FR)
  • Analytical, Physical and Theoretical Chemistry (FR)
  • Chemical Engineering (FR)
  • Chemistry and Life Sciences (EN)

• New M1 Chemistry & Innovation

https://www.psl.eu/en/education/masters-degree-chemistry
Masters @ Chimie ParisTech

- Material Science and engineering
  - Materials and Engineering Sciences in Paris (EN)
  - Materials of the future, Design and Engineering (FR)
  - Microfluidics, fluid science engineering (FR)


- BME BioMedical Engineering with
  - Bioimaging (EN)
Masters @ Chimie ParisTech

- Energy (EN)
  - Sustainable Energy & Materials
  - Energy Efficiency
  - Decarbonation of fuels
  - Renewable Energy, grids

https://www.psl.eu/en/education/master-s-degree-energy

- Nuclear Energy with
  - Fuel Cycle (EN)
Our PhD programmes

• Chemical engineering and advanced technology

• Physical chemistry and analytical chemistry

• Molecular chemistry

• Material physics and chemistry

https://www.chimieparistech.psl.eu/en/programs/phd/
IMPLEMENTATION OF EXCHANGES
Our International network
Regular international mobility Exchange “engineering track”

Y1
1 Sept - 31 Dec
1 Jan - 30 Apr
1 May - 30 Jun

Y2
01 Sept - 31 Dec
01 Jan - 30 Mar
01 Apr - 30 Aug

Y3
1 Sept - 31 Jan
1 Feb - 31 Jul

https://www.chimieparistech.psl.eu/erasmus/
International mobility – “Master track”

M1
1 Sept-30 June
Including 3-4 months of Internship

M2
1 Sept-31 Jan → 1 Feb-31 Jul
Internship

Double Degree agreement
3 semesters @ Chimie ParisTech & 2 internships

Y1
1 Sept-31 Dec → 1 Jan-30 Apr → 1 May-30 Jun

Y2
1 Sept-31 Dec → 1 Jan-30 Mar → 1 Apr-30 Aug

Y3
1 Sept-31 Jan → 1 Feb-31 Jul

Courses are taught in French
International students services

- **Accommodation**
  - Provided for international students in double degree
  - Affordable rents: ~ €340 pm
  - Possibility of accommodation allowance
  - Average living costs in Paris: €800 pm

- **PSL Welcome Desk (visa…) & Student association**

- **Intensive Language Training Programs**

- **Mentoring by senior students**

- **Active participation in student activities**
Double degree with Russian partners

Prep classes

1st year

2nd year

3rd year

4th year

Selection

M1

M2

NB: Mandatory internship in Russia
Double degree with Russian partners

1st year
2nd year
3rd year
Selection
3rd year
4th year
M1
M2
Double Degree
Double degree with Latin American partners

Eng. 3  Eng. 4  Eng. 5

1st year  2nd year  3rd year

Selection

Double Degree
Double degree with Latin American partners

1st year
2nd year
3rd year

Selection

Eng. 3
Eng. 4
Eng. 5

Internship

Double Degree
Double degree with Chinese partners

1st year
2nd year
3rd year

4th year

Selection

Degree

Double Degree
Double degree with Chinese partners

1st year → 2nd year → 3rd year → Selection → 3rd year → 4th year → M1 → M2 → Double Degree
Double degree with Polytechnique Montreal

1st year 2nd year 3rd year

Selection

4th year

Double Degree

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Double degree with Polytechnique Montreal

1st year

2nd year

3rd year

Selection

intégration

Maitrise

Maitrise

Recherche

2nd year

4th year

Double Degree

Double Degree
Double degree with KAUST

Prep classes → Selection → Internship → M2 → Double Degree → PhD (3 years)

Cosupervision of Master’s thesis
Double degree with KAUST

KAUST  →  Chimie ParisTech | PSL

Prep classes

2nd year

M1

Selection

3rd year

M2

PhD

Double Degree

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Double degree with INSAT

1st year

2nd year

3rd year

Double Degree

Selection

4th year

5th year
Double degree with INSAT

1st year

2nd year

3rd year

Selection

2nd year

4th year

M1

M2

Double Degree

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Double degree with KTH

Prep classes → 1st year → 2nd year → 3rd year

BSc 2 → M1 → M2

Selection

NB: end of study project either in France or in Sweden
Double degree with KTH

1st year

2nd year

3rd year

Selection

BSc 1

BSc 3

M1

M2

Double Degree
Double degree with Politecnico di Milano

1st year

2nd year

3rd year

Selection
Double degree with Politecnico di Milano

1st year

2nd year

3rd year

Selection

BSc 1

BSc 3

M1

M2

Double Degree
International Relations Office

Dr. Fethi Bedioui, Director
Mr. Antoine Mercier, Deputy
Mrs. Eloïse Hubert, Manager

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