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

\[
\text{H}_3\text{C}-\text{Cl} + \text{AlCl}_3 \xrightarrow{\text{AlCl}_3} \text{CH}_3 \quad + \quad \text{HCl}
\]

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

- 1899-1907: Directed by Henri Moissan (Nobel Prize winner 1906)
- 1916: First woman embracing engineer career in France
- 1904: Eugène Schueller, founder of L’Oreal Paris
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

- Chimie ParisTech
- ENS
- MINES ParisTech
- Conservatoire National Supérieur Dramatique
- École nationale des chartes
- ESPCI Paris
- Dauphine Université Paris
- Collège de France
- Institut Curie
- CNRS
- Inserm
- India

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

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

- SCIENCE
- ARTS
- HUMANITIES AND SOCIAL SCIENCES
- ENGINEERING

- 50 startups founded
- ~70 patents/year
- 2,500 business partnerships
- 150 ERC since 2011

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

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

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

- 12,000 students
- 1,500 doctoral candidates
- 56 teaching and research chairs
- 1,500 professors
- 120 partner companies
- 90,000 Alumni
- 12,000 doctoral candidates
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

Researchers and Professors & Associate Professors 140

1 Prof for 3 students

Practical training

40%

Business, management and human skills

20%

Mandatory internship

12 months

100% abroad

20% international students

Prof for 3 students
Researchers and Professors & Associate Professors

PhD and post-docs

Research Teams

Laboratories

7 per week

100%

cnrs Label

erc

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Research & Development

Chairs With Eco-Systèmes

1

50% of PhD funded by companies

2 Labcom (joint lab with SMEs)

>40 Research contracts per year
Innovation & Start-Ups

Chimie Paris Innov our incubator cofunded by the European Union
➢ 6 start-ups since 2018

Plasma catalysis technology for methanation of $\text{CO}_2$

European patent [EP15202925.2] 2015

Paris FLOW Tech a new technological platform for green and sustainable continuous flow chemistry (from summer 2020)

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

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

Chimie Paris Research Institute 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
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 polymerisation**

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

• CO$_2$ 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
HIGHER EDUCATION SYSTEM

Graduate Engineering Schools 5%

PREPARATORY CLASSES
PC1 Y1 Y2 Y3 PC2

Top 5%

Universities 95%

BACHELOR
BA BA2 BA3

French baccalauréat

1 2 3

MASTER
M1 M2

PhD D1 D2 D3

Graduate Engineering Schools 5%

HIGHER EDUCATION SYSTEM

Top 5%

Universities 95%

French baccalauréat

1 2 3 4 5 6 7 8

PhD D1 D2 D3

Master level
Training top level professionals in chemistry

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

**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
Training top level professionals in chemistry

Organic and Bioorganic Chemistry
Solid State Chemistry
Nuclear 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)
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

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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)

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 Université de Paris
  – 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 université PARIS-SACLAY
  - 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
International Relations Office

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

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