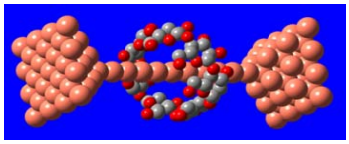
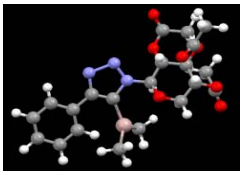
Master 2 " FRONTIERS IN CHEMISTRY "

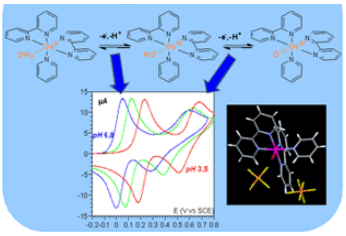
" Nano-Chemistry " and " Biologically oriented Molecular Chemistry "

http://www.biomedicale.parisdescartes.fr/-Master-PRES-.html

http://www.mms.master.univ-paris7.fr







Contacts

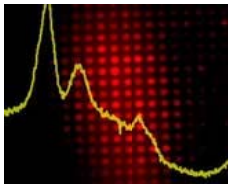
Université Paris Descartes – Chemistry Department

Prof. Olivia REINAUD, Tel : +33 1 42 86 21 83

45, rue des Saints-Pères, 75006 Paris, France

Olivia.Reinaud@parisdescartes.fr

http://www.biomedicale.parisdescartes.fr/



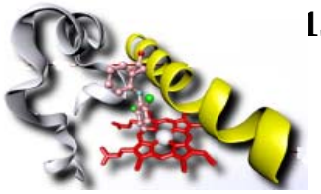
Université Paris Diderot - Chemistry Department

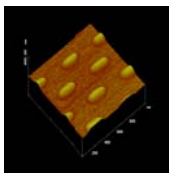
Prof. Bernd SCHOLLHORN, Tel: +33 1 57 27 87 91

15, rue Jean-Antoine de Baïf, Bât. Lavoisier, 75013 Paris

bernd.schollhorn@univ-paris-diderot.fr

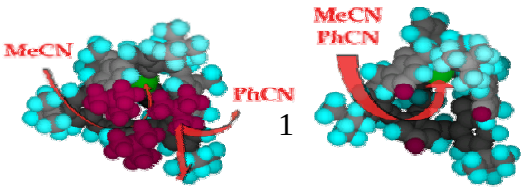
http://www.univ-paris-diderot.fr





Important dates:

- Sep 9, 2013 : First Meeting at Pa ris Descartes University, 9 AM
- First Semester Classes: Sept 16 – December 23
- Written exams: January 6 – January 10
- Second Semester Internship : January 21 - July 2013 (Oral presentation June 2013)



The Master – ***Frontiers in Chemistry*** – benefits from a dynamic and synergic collaboration of the well known top French **Universities Paris Diderot** and **Paris Descartes**. It is intended to provide a high level research-oriented training in **Molecular Chemistry at the frontiers of Biology and Nanosciences**.

A strong argument for this Master is its interdisciplinary thematic specificity, being unique and original among the other French Masters. It is based on the framework of "PRES Sorbonne Paris Cité", a new excellence network of Parisian teaching and research facilities. This allows for scientific training in various particularly promising topics dealing with new and exciting up-coming technologies and applications. Modern innovative teaching strategies such as individual tutorships, long research internships, as well as bringing together students from various countries will support the formation of future qualified researchers. The graduate students will prepare a PhD thesis either in a French laboratory or in the laboratories of international partner universities.

The first year of this Master (M1) is based on the already well established French taught chemistry study courses, whereas, **during the second year (M2), courses will be delivered exclusively in English**, starting in September 2011. Students willing to participate in the second year (M2) only, will be accepted depending on their scientific background, motivation and academic results.

First Year (M1) – 60 ECTS credits

First year courses will be held in French. During the first semester, lectures (30 ECTS) will be dedicated to provide strong bases in various aspects of chemistry. Depending on the specific programs proposed by Paris Descartes and Paris Diderot, the students will be offered courses in **nano-chemistry, synthetic methodology, coordination chemistry, supramolecular chemistry, bio-organic and bioinorganic chemistry, and spectroscopy**.

In the beginning of the second semester, the students can choose among various short courses introducing different fields related to the main topics of this Master and will benefit from English lessons. They will continue with a **three- or four-month internship in a foreign research laboratory** ending with a one week Master summer school. Student supervisors of each University will be responsible for **individual guidance and support**.

Second Year (M2) – 60 ECTS credits

English is the language of teaching and exchange during this second year. All presentations (written and oral, including the master thesis) are performed in English. The first semester is organized around **two majors** (5 courses), one to be chosen by the student: **Nano-Chemistry or Biologically-oriented Molecular Chemistry**. Two courses of the corresponding minor thematic will complete the interdisciplinary bouquet.

The common core of the program consists of an introduction to industrial regulations, communication, foreign language and research seminars. In the beginning of the year, introductory courses and tutorships will help the students to individually catch up for a better understanding of their chosen major theme. The second semester will be entirely devoted to **a bibliographic and a research project** (6 months) in one of the participating laboratories.

Finally, a one-week **Master Summer School** will be organized at the end of the academic year (July-August), bringing together all Master students (M1 and M2). During this week, invited speakers will give conferences and each student will present his/her research results in an oral communication given in English. As a result, exciting discussions between students and researchers are expected.

Master Frontiers in Chemistry, 1st year program *(in French)*

Advanced and introductory courses in:
nano-chemistry, synthetic methodology, coordination chemistry, supramolecular chemistry, bio-organic and bioinorganic chemistry, spectroscopy and theoretical modeling.

4-5 month internship in a foreign research laboratory *(student fellowships)*

More details on *http://www.biomedicale.parisdescartes.fr/-Master-PRES-.html*
and http://www.mms.master.univ-paris7.fr

Master Frontiers in Chemistry, 2nd year program *(in English)*

M2-S3

Major	Minor	Common Core	Mentored Project
15 (5x3) ECTS 5 UEs of the major theme to be chosen Theme 1 : Molecular Chemistry Or Theme 2 : Nano-chemistry	6 (2x3) ECTS 2 UEs of the minor theme to be chosen Theme 1 or 2	UE 3.13 (5 ECTS) Conferences, Patent rights, Development European regulations Communication Research lectures Foreign language (English or French	UE 3.14 (4 ECTS) Writing of a Review in the form of a Perspective

Theme 1: Molecular chemistry biologically oriented (1 item = 3 ECTS)	**Theme 2: Nano-chemistry (1 item = 3 ECTS)**
UE3.1: Reactivity: ionic, radical, photo-chemical, redox	UE3.7: Physical chemistry at nanometric scale
UE3.2: Smart molecules	UE3.8: Nanostructured surfaces
UE3.3: Bio-inorganic chemistry	UE3.9: Nanosystems and nanomaterials for electronics
UE3.4: Bio-organic chemistry	UE3.10: Molecular and Biomolecular electrochemistry
UE3.5: Supramolecular chemistry	UE3.11: Nano-biotechnology
UE3.6 : Natural compounds	UE3.12: Energy and nanoscience

M2-S4

UE 4.1 (3 ECTS) **Bibliographic Project**	**UE 4.2 (27 ECTS)** **Laboratory: Research project** **6-month internship (fellowships for foreign students)**

Detailed Program

First Semester of MASTER 2

UE 3.1 –Organic Reactivity (3 ECTS)

- ***Head of UE :*** L. Micouin
- ***Category to which belongs the course:*** Optional
- ***Duration :*** 20 h of lectures, 10h of tutoring,
- ***Knowledge control and skills assessment***: final examination
- ***Content and objectives*** :

To master the selective activation of a complex molecule. To master the selective functionalization of a non functionnal compound.

- ***Content of the course***

- C-C triple bounds activation (5h + 2h of tutoring)

Gold catalysis, electrophilic additions (carbo and hydrometalations)

- Stoichiometric Aromatic and heteroaromatic C-H or C-X bound activation (5h + 2h of tutoring)

Directed metalation, halogen-metal exchange, oxidative addtitions

- radical activation (5h + 3h de tutorat)
- aliphatic C-H bounds activation (5h + 3h de tutorat)

Using transition metals, carbenes, nitrenes,
C-C and C-X bound formation

- ***Skills :***

Rules and methods of selective activation of complex molecules, for the synthesis of complex organic molecules or molecular objects.

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
MICOUIN, laurent	DR2 CNRS	Paris Descartes, UMR 8638	Sélectivité et Diversité Moléculaire en Synthèse
PRESTAT, Guillaume	PR	Paris Descartes, UMR 8601	Synthèse de composés d'intérêt biologique
LECOURT, Thomas	MCU	Paris Descartes, UMR 8638	Sélectivité et Diversité Moléculaire en Synthèse

UE3.2 – Synthesis of biologically relevant compounds (3 ECTS)

- ***Responsibles:*** C. Gravier-Pelletier, J. Ardisson

- ***Category of teaching unit:*** Optional

- ***Number of hours:*** 20 h lectures, 10 h of tutoring

- ***Methods of control knowledge and skills assessment***: written final exam

- ***Content and objectives***:

  This course will focus on retrosynthetic analysis leading to multi-step total syntheses of biologically relevant compounds. Emphasis will be placed on understanding the choice of protecting groups and the control of chirality.

- ***Programmed learning:***

  I. Multi-step synthesis

  Chiral pool: carbohydrates, aminoacids, terpenes and derivatives.

  Examples of total synthesis of biologically relevant compounds: hydroxylated metabolites of arachidonic acid, muricatacine, carbohydrate mimics, peptidomimetics

  II. Methodologies of synthesis

  Total synthesis. New methods of synthesis. Retrosynthesis.

Skills acquired by students :

Knowledge and understanding of the tools for multi-step synthesis: main methods of synthesis, protective groups, control of chirality.

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
GRAVIER-PELLETIER Christine	DR CNRS	Paris Descartes, UMR 8601	Synthèse de composés d'intérêt biologique
ARDISSON Janick	PR	Paris Descartes, UMR 8638	Sélectivité et Diversité Moléculaire en Synthèse

UE 3.3 - Redox bioinorganic chemistry (3 ECTS)

- ***Head of UE :*** O. Reinaud

- ***Category to which belongs the course:*** Optional

- ***Duration :*** 20 h of lectures, 10h of tutoring,

- ***Knowledge control and skills assessment***: final examination

- ***Content and objectives*** :

  Structure, mechanism and reactivity of major classes of metallo-enzymes (Fe, Zn, Cu) involved in redox processes
  Activation of small molecules (H_2O_2, O_2)
  Biomimetic systems

- ***Content of the course***

Hemoproteins (6h of lecture + 4h of tutoring)

- Control and tuning of the heme reactivity by the protein backbone : electron transfer, O_2 (P-450, cyclooxygenase) and H_2O_2 (peroxidases, catalase) activation
- Rational design of biomimetic system for oxidation catalysis

Non-heme Fe-enzymes (5h + 3h of tutoring)

- Non-heme acive site for oxidation catalysis : catechol dioxygenase, aromatic-hydroxylase, alpha-ketoglutarate enzymes)

Copper proteins (8h + 4h of tutoring)

- Types 1 et A : electron transfer
- Type 2 : oxidase (with a co-factor) or monoxygenase (with a reductant) activity
- Type 3 : from O_2 transport O_2 activation (hemocyanine, catecholase, tyrosinase)
- 4 electron reduction of O_2: laccases, cytochrome c oxidase
- Biomimetic systems

- ***Skills :***

  Knowledge and understanding at the molecular level of redox reaction catalyzed by metallo-enzymes and design of biomimetic systems

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
REINAUD, Olivia	PR1, section 32	Paris Descartes, UMR 8601	Chimie bio-inorganique supramoléculaire
ARTAUD, Isabelle	DR	Paris Descartes, UMR 8601	Chimie bio-inorganique pharmacochimie, catalyse
MAHY, Jean-Pierre	PR1	Paris Sud UMR 8182	Chimie Bioorganique et Bioinorganique

UE 3.4 – Bio-organic chemistry (3 ECTS)

- ***Head of UE :*** I. Artaud

- ***Category to which belongs the course:*** Optional

- ***Duration :*** 20 h of lectures, 10h of tutoring

- ***Knowledge control and skills assessment***: final examination + tutoring

- ***Content and objectives*** :

Knowledge of basic reactivity of enzymes with co-factors, understanding redox cascades and radical reactivity in biological media, biochemistry of sulfur derivatives
Interaction and reactivity of nucleic acids

- ***Content of the course***

Fundamentals of reactivity at the active site of an enzyme
- acid-base, nucleophilic catalysis
- flavo-enzymes

Redox cascades, biological radicals
- radicals, oxidative stress, antioxidants
- (bio)chemistry of reactive species derived from dioxygene and dinitrogen

(Bio)chimistry of sulfur
- cysteine, cystine, glutathion, methionine, taurine, SAM
- synthesis, characterization and reactivity of oxidized derivatives of sulfur
- role of sulfur derivatives in biology

(Bio)chemistry of nucleic acids
DNA, RNA, aptamers : ribozymes, DNAzymes, quadruplex

- ***Skills :***

Knowledge and understanding of the chemistry mediated by co-factors, radical species and sulfur compounds in biological systems. Essentials of biological chemistry of nucleic acids.

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
ARTAUD, Isabelle	DR	Paris Descartes, UMR 8601	Chimie bioinorganique, pharmacochimie, catalyse
BOMBARD, Sophie	CR	Paris Descartes	

UE 3.5 – Supramolecular chemistry (3 ECTS)

- Head of UE : O. Reinaud – B. Colasson

- Category to which belongs the course: Optional

- Duration : 15h of class, 15h for analysis of article.

- Knowledge control and skills assessment: final exam + presentation of articles

- Content and objectives :

This class will give the students more insights into modern supramolecular chemistry. The notions in molecular recognition will be developed such as for the control of the reactivity within a supramolecular system. Also, new properties stemming from the supramolecular aspect of the objects will be discussed (for instance, the stereochemistry in supramolecular systems).

- Content of the course

A/ Supramolecular chemistry

1 – Molecular receptors

Crown ethers, cryptands, spherand, cyclodextrines, calixarenes, cucurbituryles, capsules

2 – Host-Guest Chemistry: recognition of cations, anions and neutral molecules

Medium effect, methods for evaluation of K_{ass}.

3 – Reactivity in supramolecular chemistry.

a) reactions in a confined space (artificial ou biological)

(stereo)selectivity - stabilization of intermediates *vs*. rate acceleration

b) supramolecular combinatorial chemistry (search for new catalysts, drug discovery)

4- Molecular devices

a) Specifications
b) Florescent sensors
c) Other probes

B/ ***Bio-supramolecular chemistry***

1 - Biological receptors (ptoteines and nucleic acids), determination of K_d

2 - Conception of « ligands » and neutralizing antibodies

3 - Probes (fluorescence, FRET, BRET…)

2 *Illustrations :*

→ *Receptors with tyrosine kinase activity, phosphorylations and related cascades*

→ *Receptors coupled to G proteins : various mode of activation*

- Skills :

Critical analysis of the works published in the specialized literature. Comprehension of the whys and hows of the research in the field.

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
REINAUD, Olivia	PR1, section 32	Paris Descartes, UMR 8601	Chimie bio-inorganique supramoléculaire
COLASSON, Benoit	MC, section 32	Paris Descartes, UMR 8601	Chimie bio-inorganique supramoléculaire
VIDAL, Michel	PR	Paris Descartes, UMR 8638	

UE 3.6 – Natural products : synthesis and biosynthesis (3 ECTS)

- Head of UE : M. Vidal

- Category to which belongs the course: Optional

- Duration : 20 h of lectures, 10h of tutoring

- Knowledge control and skills assessment: final examination + tutoring

- Content and objectives :

Proteic and peptidic synthesis and biosynthesis, fundamentals of glyco(bio)chemistry

Understanding secondary metabolism pathways for the exploration and elaboration of retrosynthetic biomimetic schemes.

- Plan détaillé :

1. Proteic and peptidic synthesis
2. Diversity and role of secondary metabolites (communication, adaptation…).
- major pathways of secondary metabolism
- major reactions in secondary metabolism
- Methodologies for studying secondary metabolism
3. Biosynthesis and stereochemistry – Hemisynthesis – biomimetic synthesis
4. Glycochemistry and bio-glycochemistry

- Skills :

Knowledge of major families of small biological molecules and their biosynthetic metabolism

Name	Position, thematic section	Institution	Research group
Sorbonne Paris Cité : Frontiers in Chemistry			
VIDAL, Michel	PR	Paris Descartes UMR 8638	
Roussy, F		Paris Descartes UMR 8638	
Liu, WQ		Paris Descartes UMR 8638	

UE 3.7 – Physical chemistry at nanometric scale (3 ECTS)

- ***Head lecturers :*** **J.-C. Lacroix**
- ***Credits / Type*:** **3 ECTS / *optional***
- ***Evaluation*** **: final exam**
- ***Global time table :*** **30 h (lectures)**

- ***Content and objectives*** :

This course is an introduction in the principal concepts of physical chemistry at nanometric scale and resulting applications. Physical and chemical surface properties and the different characterisation methods of interfaces are presented and microscopic as well as macroscopic aspect will be discussed. The third part is focused on force field and tunneling microscopy, nowadays frequently used in physics, chemistry and biology laboratories. The students will learn how to extract topographic information using these techniques and how to determine the physical and chemical properties of a given sample with high spatial resolution.

- ***Detailed program:***

1) Nanoelectrochemistry and molecular electronics (Jean-Christophe Lacroix, 10 h)
The two main domains of this cours are supramolecular chemistry and molecular electronics. In this respect it is complementary to the program of **UE 3.8** and **3.9**.

a) General concepts on the process of molecular recognition (multiple recognition with and without cooperative effects and strategies how to conceive functional systems).
b) Description of intramolecular electron transfer mechanisms and recent examples in research (in the context of supramolecular organization and self-assembly).

2) Physical and chemical surface properties (Michel Delamar, 10 h)
Introduction: ideal and real surfaces; interfaces and characterisation methods
Microscopic aspects: surface/ molecule interactions
Macroscopic aspects
Molecular adhesion
Examples

3) Force field microscopy (N. Battaglini, 10 h)
- Introduction: Historial aspect of the technique, microscopy with a local probe
- Tunneling microscopy (STM): instrumentation, applications
- Force Field Microscopy (AFM): different working procedures

Name, First name	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
Delamar Michel	PRex, section 31	Paris Diderot	UMR 7086		
Lacroix Jean-Christophe	Pr1 section 32	Paris Diderot	UMR 7086		
Battaglini, Nicolas	Pr2	Paris Diderot	UMR 7086		

UE 3.8 –Nanostructured surfaces. Functionalization and elaboration (3 ECTS)

- ***Head lecturers :*** **MC Pham / B. Schöllhorn**
- ***Credits / Type*:** **3 ECTS / *optional***
- ***Evaluation* : final exam (70%) + control (20%)**
- ***Global time table :*** **26 h (lectures), 6 h (tutoring)**

- ***Content and objectives*** :

Chemical Surface Functionalization : Electronic Conducting Polymers; Functional Monolayers **; Materials at the Nanoscale (Magnetic Properties)**.

- ***Detailed program:***

1) Chemical Functionalisation of Surfaces - Electronic Conducting Polymers
(M C Pham , 10h lectures, 2h tutoring)
Content : "Electrochemically modified electrodes" can be obtained by surface functionalization and in particular by using Electronic Conducting Polymers (ECP). The 1st part of this course is dealing with the elaboration and the properties of modified electrodes. The 2nd part is related to ECPs: structure and properties – doping reactions – chemical and electrochemical synthesis - ECP functionalization (being important for numerous applications). The most important electrochemical applications will be discussed: batteries, electrocatalysis, corrosion protection electrochemical sensors and biosensors.
Evaluation: oral exam - discussion of a research article (choice among several publications distributed one or two weeks before the examination).

2) Organic and organometallic monolayers (B. Schollhorn, 6 h lectures, 4h tutoring)
A survey over the most important methods for the fabrication and elaboration of molecular monolayers will be given. Selected applications in research and industrial technology will be treated.
Evaluation: written exam.

3) Synthesis of materials at the nanoscale: magnetic properties ***(*R. Brayner, 10h lectures, 2h tutoring)**
The major categories of nanomaterials; overview of methods for preparing nanostructured materials (physical, chemical and mechanical). Synthesis of nanoparticles by chemical liquid phase nucleation and growth, prevention of coalescence of particles, growth control by use of structural, anisotropic growth. Examples: metals and alloys, ceramics, semiconductors.
The energetic contributions: Effects of size, Size characteristics; Magnetic materials and sample applications
Evaluation: written exam

During the three courses the students will be taught the comprehension of the tools and the strategies for the elaboration and the functionalization of surfaces and the fabrication of nanostructured objects and materials.

Name, First name	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
MC Pham	PRex, section 31	Paris Diderot, UMR 7086	ITODYS		
B. Schöllhorn	PR2, Section 32	Paris Diderot, UMR 7591	LEM		
R Brayner	MCF, section 33	Paris Diderot, UMR 7086	ITODYS		

UE3.9 – Nanosystems and Nanomaterials for electronics (3 ECTS)

- ***Head lecturer :*** **N. Felidj**
- ***Credits / Type:*** **3 ECTS /** ***optional***
- ***Evaluation*** **: final examen**
- ***Global time table :*** **30h (lectures)**

- ***Content and objectives*** :
Nanoelectrochemistry and molecular electronics ; **physical chemistry of polymers for electronic components ;** nanostructured surfaces, metal nano-structures; nanotubes.

- ***Detailed program:***

1) Physico-chimie des composants électroniques plastiques (diode, transistor, photovoltaique) (G. Horowitz, 10 h)

Organic (or plastic) electronics is an emerging domain that aims at realizing electronics devices made of organic materials (polymers and small molecules). This lecture is an introduction to this new domain. First, we show how some organic materials behave as semiconductors, and in what they differ from their inorganic counter-parts, like silicon. Next, we present various organic electronic devices (diodes, transistors, opto-electronic devices) and detail their operating mode. Finally, we describe the specific fabrication techniques of organic electronics.

2) Nanostructured surfaces, metal nano-structures: optical properties (N. Félidj, 10 h)

Metallic nanoparticles (mainly gold, copper, silver) which size is much smaller than the incident light wavelength, lead to collective oscillation of conductive electrons at the particle surface, the so-called “localized surface plasmon”. Such an optical phenomenon leads to a very high electric field enhancement at the particle surface. The goal of this lecture is to show all the possible applications using plasmonics structures in the context of high sensitive spectroscopies such as fluorescence or Raman scattering.

3) Nanotubes (M. Lamy de la Chapelle, S. Farhat, 10 h)
Chemistry of nanotubes: nanotube synthesis (catalytic synthesis, growth processes...) polymorphism and nanotube structures, thermodynamic, synthesis of hetero-atomic nanotubes.
Physics of nanotubes: structural properties, interaction light-matter, electronic properties, mechanical properties, vibrational properties, properties determination (characterisation methods, measurements...)
Applications: composite, biological applications, field emission, energy storage, nanoelectronics...

Name, First name	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
G. Horowitz	DR1, Section 13	Paris Diderot, UMR 7086	ITODYS (UMR 7086)		
N. Felidj	PR2, Section 31	Paris Diderot, UMR 7086	ITODYS (UMR 7086)		
M Lamy de la Chapelle	PR	Paris 13	Laboratory CSPBAT FRE3043		
S. Farhat	MC	Paris 13	Laboratoire CSPBAT FRE3043		

UE3.10 – Molecular and biomolecular electrochemistry (3 ECTS)

- ***Head lecturer :*** **Marc Robert**
- ***Credits / Type*:** **3 ECTS / *optional***
- ***Evaluation* : final exam (80%) + tutoring (20%)**
- ***Global time table :*** **26 h (lectures), 6 h (tutoring)**

- ***Content and objectives*** :

This course is intended to give a detailed introduction to molecular and biomolecular electrochemistry, both in terms of concepts and techniques, in order to study complex processes and reactions involving electron transfer and coupled chemical reactions, in small organic molecules as well as in more complex biological molecules, like, e.g., redox enzymes or proteins, and DNA. Emphasis will be put on reactivity and analytical and imaging techniques, with examples related to biotechnology, medical diagnosis but also catalysis (activation of small molecules in relation to the contemporary renewable energy challenges).

- ***Detailed program:***

1. Molecular electrochemistry (14 h)

Elements of molecular electrochemistry (kinetics, experimental methods, reactivity, complex processes, modelisation, electrochemical microscopy)

Mechanisms in molecular electrochemistry
Reactions, kinetics and reactivity of short intermediates using time resolved techniques
Models and theory of electron transfer
Electrochemical microscopy
Seminars : Breaking bonds with electrons and protons (dissociative electron transfers, proton-coupled electron transfers)

2. Biomolecular electrochemistry (12 h)

Enzymes and redox proteins – Enzymatic electrocatalysis, Enzymatic electrodes

Introduction to proteins; Redox proteins – Electrochemistry of redox enzymes – Direct and mediated electron transfers. – Enzymatic electrocatalysis. – Enzymatic electrodes - Applications to biotechnology

Electrochemical transducers, applications

Surface modified electrodes. Introduction, methodologies, theoretical aspects
Methods and techniques
Analytical applications (signal transduction for molecular and bio-molecular recognition)

3. Tutoring + TP (6h) : Bibliographic project and article analysis + TP

Name, First name	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
Robert, Marc	PR1, CNU 32	Univ. Paris Diderot	LEM (UMR 7591)		
Limoges, Benoit	DR2 CNRS	CNRS – Univ. Paris Diderot	LEM (UMR 7591)		
Mavré, François	MCF, CNU 31	Univ. Paris Diderot	LEM (UMR 7591)		
Ghilane, Jalal	CR CNRS	CNRS – Univ. Paris Diderot	ITODYS (UMR 7086)		
Costentin, Cyrille	PR2, CNU 32	Univ. Paris Diderot	LEM (UMR 7591)		

UE 3.11 – Nanobiotechnology (3 ECTS)

- ***Head lecturer :*** **Vincent NOEL**
- ***Credits / Type*:** **3 ECTS / *optional***
- ***Evaluation* : final exam**
- ***Global time table :*** **26 h (lectures), 6 h (help session - tutorial)**

- ***Content and objectives*** :

This course focuses on the numerous connections between nanosciences and biology and the interest to combine these two disciplines for the development of innovative devices and systems. By the end of the course, students will have a detailed knowledge of the technological and fundamental challenges of nanobiotechnologies.

- ***Detailed program:***

- **Vector-mediated drug delivery**: Chemical Physics of Colloids applied to Biology, Organic Nanomaterials.
- **DNA/Proteins/glycosides chips**: Functionalization and Sensing strategies, Fields of Application - research, diagnostic, health, agribusiness ,….
- **Imagery and Therapy**: Colloidal systems for Imagery and Therapy, Cells Labelling and Contrast Agents, Cellular Hyperthermia.
- **Contribution of Biology to Nanostructures Building:** Biomimetics Systems, Programmed Supramolecular Architectures based on Biomolecules and Nano-objetcs - nanoparticles, nanotubes…

Name, First name	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
V. Noel	MCF, section 31	Paris Diderot,	UMR 7086, ITODYS		
C. Mangeney	MCF, section 31,	Paris Diderot,	UMR 7086, ITODYS		
S. Ammar	PR	Paris Diderot,	UMR 7086, ITODYS		
B. Piro	MCF, section 31	Paris Diderot,	UMR 7086, ITODYS		
D. Marchal	MCF, section 31	Paris Diderot,	UMR 7086, ITODYS		
F. Barbault	MCF, section 31	Paris Diderot,	UMR 7086, ITODYS		
R. Brayner	MCF, section 33	Paris Diderot,	UMR 7086, ITODYS		

UE3.12 – Energy and Nanosciences (3 ECTS)

- ***Head lecturer :*** **Marc Robert**
- ***Credits / Type*:** **3 ECTS / *optional***
- ***Evaluation* : article analysis and presentation**
- ***Global time table :*** **14 h (lectures), 16 h (tutoring)**

- ***Content and objectives*** :

This course is intended to give a detailed introduction to the contemporary challenges associated to the development of renewable energy, mainly solar energy, at a global scale, and the role of emerging nanosciences in designing and inventing molecular systems as well as new materials able to store and produce energy using mainly light as a an energy source.

- ***Detailed program :***

1. Introduction. Energy challenges and nanosciences
2. Nanomaterials for storing and producing energy
   Storage (supercapacitors, Li batteries)
   Producing (batteries, photovoltaïcs and solar fuels)
3. Molecular (bio-inspired) systems
   Introduction
   Photosynthesis, a green (bio)-chemistry using visible light
   Small molecules activation: water oxidation, proton reduction, carbon dioxyde reduction

Tutoring will include article analysis and presentation as well as practical training experiments (design of a photovoltaïc 'tGrätzel' cell and design of a nanomaterial based supercapacitor)

Name, Firstname	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
Robert, Marc	PR1, CNU 32	Univ. Paris Diderot	Laboratoire Electrochimie Moléculaire (UMR 7591)		
Randriamahazaka, Hyacinthe	PR2, CNU 32	Univ. Paris Diderot	Laboratoire Itodys (UMR 7086)		
Martin, Pascal	MCF, CNU 31	Univ. Paris Diderot	Laboratoire Itodys (UMR 7086)		

UE 3.13 Common core - (5 ECTS)

- Head lecturer : **S. Michel, B. Schöllhorn**

- Credits / Type*:** **5 ECTS / *compulsory course

- Evaluation **: reports, presentation, article analysis and control (complete compensation)**

- Global time table : **16h (lectures), 20h (seminars), 14h (tutoring)**

- Content and objectives :

An important goal of this course is to learn about various aspects concerning research and development in non academic institutions. Necessary knowledge about patents, intellectual and industrial property will be completed by human and social aspects treating aspects of communication important for management and job interviews. Chemistry development will be addressed as an inevitable link between applied research and industrial production. Last but not least the essential notions about "health and safety" as well as the treatment of chemical waste will be discussed. 2 credits will be attributed to a foreign language preferentially English (or French for foreign English speaking students).

- Detailed program :

A) Research and development – European Economics, Human Resources and Legal Environnement (3 ECTS)

1) Patents, trademarks, industrial and intellectual property
Invention, patents

2) Research and Development (R&D)
Pharmaceuticals, materials

3) Communication and human resources
Communication, job interview, cv …

4) Environment, health and safety
European legislation – standards and norms (REACH…)

5) Scientific seminars
6 seminars, 3 at Paris Descartes and 3 at Paris Diderot (report)

B) Foreign language (2 ECTS)

Name, Firstname	Position, thematic section	Institution	Research group		
Parcours Sorbonne Paris Cité : Frontiers in Chemistry					
Michel, Sylvie	PR1, section 86	Paris Descartes,	UMR 8638		
Dufat, Thi-Hanh	MCU, Section 86	Paris Descartes	UMR 8638		
Laurent Micouin	DR2 CNRS	Paris Descartes, UMR 8638	Sélectivité et Diversité Moléculaire en Synthèse		
Bernd Schöllhorn	PR2, Section 32	Paris Diderot, UMR 7591	LEM		
Matteo Merzagora	Priv.				

UE 3.14 – Introductory courses (4 ECTS)

- Head lecturer : **O. Reinaud, B. Schöllhorn**

- Credits / Type: **4 ECTS / *compulsory course***

- Evaluation **: control / tutoring**

- Global time table : **40 h (tutoring) including several hours of personalized lectures during the first 3 weeks of the year.**

- Course description :

In the beginning of the year, introductory courses and tutorships will help the students to individually catch up for a better understanding of their major theme. Students who have not followed the first year of this master will have the opportunity to access the UE 1.4 (M1).

- Detailed program :

After discussion with the tutors and based on the individual skills of the student a choice among the following domains can be made:

- Molecular modeling (J.C. Lacroix)
- Coordination chemistry (D. Over)
- Supramolecular chemistry (B. Colasson)
- Nanochemistry (B. Schöllhorn)
- Biological chemistry (O. Reinaud, J-N. Rebilly)
- Synthetic strategies (L. Micouin, H. Dhiman, J. Ardisson)
- Spectroscopies (O, Reinaud, temporaire)

Name	Position, thematic section	Institution	Research group
Parcours Sorbonne Paris Cité : Frontiers in Chemistry			
B. Schöllhorn	PR, Section 32	Paris Diderot, UMR 7591	LEM
R. Olivia	PR, section 32	Paris Descartes UMR 8601	Chimie bioinorganique supramoléculaire
J.C. Lacroix	Pr section 32	Paris Diderot	UMR 7086
D. Over	MC, 32	Paris Descartes, UMR 8601	Chimie bio-inorganique supramol
J-N. Rebilly	CR	Paris Descartes, UMR 8601	Chimie bio-inorganique supramol
L. Micouin	DR	Paris Descartes, UMR 8638	
H. Dhiman	PR, Section 32	Paris Descartes, UMR 8601	
J. Ardisson	PR	Paris Descartes, UMR 8638	
G. Prestat	PR, Section 32	Paris Descartes, UMR 8601	

Second Semester

UE 4.1 : Bibliographic project (5 ECTS)

Head: **O. Reinaud, B. Schöllhorn**

- Credits / Type: **5 ECTS / *compulsory course***

- Evaluation **: Written report and oral presentation**

- Course description:
The subject of the bibliographical report will be chosen in relationship with the research project, and will be based on 10 to 20 references. A written report (ca. 10 pages) has to be prepared. The oral presentation of this report (10 min) will be followed by an open discussion with the referees (10 min).

UE 4.2: Internship in a laboratory : research project (25 ECTS)

Head: **O. Reinaud, B. Schöllhorn**

- Credits / Type: **25 ECTS / *compulsory internship***

- Evaluation **: Written report / oral presentation**

- Course description:
A 6 months internship in a research laboratory followed by a written report (ca. 20 pages) and an oral presentation (15 min + 10 min questions)