ParisTech
INSTITUT DES SCIENCES ET TECHNOLOGIES
PARIS INSTITUTE OF TECHNOLOGY

ÉCOLE POLYTECHNIQUE

MSc in Engineering

Département d'Enseignement et de Recherche

Program Language: French

Program Contents :

Départements:

- Biologie
- Chimie
- Economie
- HSS
- Informatique
- Modern Languages and Communication
- Mathèmatiques appliquées
- Mathèmatiques
- Mécanique
- Physique

MSc in Engineering

Biologie

Program Language: French

Content:

There is no doubt that biology is in the midst of a revolution. The amount of data to exploit and interpret has grown enormously, so that new technologies are needed, which rely on engineering and physical sciences such as computer science, chemistry or optics. The students of Polytechnique have the opportunity to take a broad range of biology courses, many of which are interdisciplinary. They will thus be well prepared for this changing field and its many professions. The courses offered are nourished in part by the research activities of two laboratories on our campus: the Laboratoire de Biochimie and the Laboratoire d'Optique et Biosciences. Through these laboratories, the school is an active participant in current research, including interdisciplinary research and partnerships with many of the other departments at Polytechnique. Several courses are organized jointly with other departments.

Program Contents :

Années

- Biologie année bac + 4 (année 2)
- Biologie année 3 (année bac+5) :
- Biologie quatrième année professionnalisante

Laboratoires

- Laboratoire de Biochimie (BIOC)
- Laboratoire d'Optique et Biosciences (LOB)

Last Modification: Mon 21 March 2011

MSc in Engineering

Biologie année bac + 4 (année 2)

Program Language: French

Content:

The second year courses are meant to give a basic knowledge of biology to as many students as possible, and to allow the future engineer or executive to make decisions that are informed and scientifically sound. Indeed, biological questions are increasingly pervasive in the socio-economic world, and the biology training received at Polytechnique will be needed by our graduates at some point in their careers. The prior training of the students is uneven.
Therefore, our second year courses include a basic grounding in molecular and cell biology, providing a passport for the other biology courses, both in the 3rd and 4th years. After 2nd year molecular and cell biology, several tracks are possible for those who wish to specialize. Two new short courses are offered, in ecology and in molecular physiology. Finally, an experimental course is offered that introduces them to modern experimental methods in the life sciences.

Last Modification: Mon 21 March 2011

MSc in Engineering

Biologie année 3 (année bac+5) :

Program Language: French

Content:

This third year program is for students who want to explore the properties of living matter at increasing levels of integration: genetics, cloning, cellular architecture and differentiation, cell networks, brain development, populations, biodiversity, genomics. The aim is to increase the students basic biological knowledge in these domains.

For students who seek to a multidisciplinary formation, interface programs are also offered, including :
-biology-physics-chemistry,
-biology-informatics,
-biology-modelling.

These programs involve several departments and give students solid bases for a specialization in many

domains related to health, agrochemistry, environmental science, chemistry,…
Two themes are proposed: “Cells, organisms, genomes, evolution” and “Biology at the interfaces”.

Each theme allows students to study the most recent advances in biology, which are revolutionizing life sciences and biotechnology.

Last Modification: Mon 21 March 2011

MSc in Engineering

Biologie quatrième année professionnalisante

Program Language: French

Content:

Teachings referents:
- Yves Méchulam
Associated professor
Mél : yves.mechulam@opolytechnique.edu
- Loïc Lepiniec
Senior Lecturer
Mél : loic.lepiniec@versailles.inra.fr
- Emmanuelle Porcher
Senior Lecturer
Mél : porcher@mnhn.fr

The department proposes two basic options:
1) An engineering training with a double degree, involving one of the following partner schools:
* AgroParis Tech (track « Agronomie » or « Water and Forrests »
* Ecole Nationale Supérieure des Mines Paris Tech de Paris (Bio-technology)
* Ecole Nationale Supérieure des Techniques Avancées Paris Tech (Environment)
* Ecole Supérieure de Physique et Chimie Industrielles Paris Tech (Bioengineering)
* Ecole Nationale Supérieure de Chimie Paris Tech

2) A research specialization in France or Europe
The department takes part in the school's Masters in Science and Technology. The biology program is entitled Molecular and Cellular Biology. The 4th year specialization is entitled “Engineering of Biomolecules”. The students can also follow a variety of other Masters programs in the general area of “Biology, medecine, health”, depending on the doctoral program and the research laboratory chosen (which

could belong to any of the main research agencies: CNRS, INSERM,INRA,PASTEUR,CEA, etc.).

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MSc in Engineering

Laboratoire de Biochimie (BIOC)

Program Language: French

Content:

Laboratoire de Biochimie (BIOC) :
www.bioc.polytechnique.fr

The research interests of the laboratory of Biochemistry (BIOC) revolve around four themes: the macromolecular interactions at the origin of the translation of messenger RNAs into proteins, detoxification systems with an interest in molecular pumps, the development of nanobiosensors, and structural bioinformatics.

1. BIOC identifies the components of the large macromolecular complexes involved in the translation of the genetic message, in order to obtain a structural and functional description of these complexes. The final goal is a global description of proteosynthesis including relationships with other complex cellular processes.
2. The project on intoxication and detoxification aims at identifying the metabolic pathways disturbed by several toxic agents, as well as the cellular responses involved in detoxification. BIOC is mainly focused on selenium. This metalloid is especially important since its regular administration to humans, at subtoxic levels, reduces the incidence of several cancers. Yeast has been chosen as a model system to understand the toxicity pathways of selenium.
3. The development of biosensors is a pluridisciplinary project based on an original fabrication process of silicon nanowires developed by a physics laboratory of the Ecole Polytechnique.
4. Structural bioinformatics is focused on biomolecular interactions and on the engineering of these interactions. Targeted interactions include several complexes between enzymes of the translational machinery and their substrates or inhibitors: amino acids, RNAs, antibiotics. Another target is the complex between the HIV protein gp120 and small inhibitory proteins.

Last Modification: Mon 21 March 2011

MSc in Engineering

Laboratoire d'Optique et Biosciences (LOB)

Program Language: French

Content:

Laboratoire d'Optique et Biosciences (LOB) :
www.lob.polytechnique.fr

The work we are performing in the domains of femtosecond spectroscopy and related technologies has contributed in elucidating ultrafast molecular dynamics in biological molecules playing a role in oxygen transport, bacterial photosynthesis, oxidative metabolism as well as primary processes in vision through the studies of bacteriorhodopsin, a bacterian analog of rhodopsin. To achieve these experiments, we have developed original techniques (spectral continuum amplification, optical rectification in the femtosecond regime, characterization methods for femtosecond pulses, femtosecond X-ray diffraction, etc.). In the last few years, an important part of our projects deals with the observation and control of in vivo reactions by associating nonlinear microscopy, coherent control and intracellular femtosecond photoablation. Laboratory for Optics and Biosciences (LOB) relies on a project-based rather than team-based organization. The research team composition is not permanent and is rearranged according to the undertaken research projects. This method of organization is particularly suited to our laboratory due to the pluridisciplinary researchs being pursued.

One project in collaboration with the group of H. Myllykallio at University Paris XI in Orsay concerns structure-function analyses and the environmental/oxygen regulation of a new class of thymidylate synthases, ThyX. These enzymes perform the conversion of dUMP into dTMP, an essential DNA precursor. Found in a large number of human bacterial pathogens, among them Helicobacter pylori and Campylobacter jejuni, ThyX enzymes represent attractive targets for specifically inhibiting microbial growth. As ThyX proteins are present in many anaerobic or microaerophilic bacteria, we are currently exploring the link between nucleotide and oxygen metabolisms in these organisms by studying the effect of O2 on in vivo thymidylate synthesis in Helicobacter pylori.

A second project concerns the coherent vibrational control in proteins: Vibrational climbing is a method for controlling the vibrational motion of a molecular bond in the coherent regime and on a timescale shorter than intramolecular vibrational relaxation. Such an approach relies on the use of a resonant infrared pulse with a frequency chirp accounting for the anharmonicity of the vibrational potential. We have shown that coherent vibrational climbing could be applied to a molecule as complex as a protein, here carboxyhemoglobin, by exciting the vibration of the CO ligand using chirped infrared pulses.

The laboratory has undertaken an important research project on in situ functional microscopy aiming both at developing new microscopy techniques and at applying them to biological and biomedical imaging. A major part of this project deals with nonlinear microscopy, a method which makes use of a nonlinear process such as multiphoton excited fluorescence, harmonic generation or stimulated Raman emission. Two biological projects take profit of this methodological development. The first one aims to gain insight into the mechanisms whereby hypertensive conditions lead to renal and vascular fibrosis. Our working hypothesis is that progression and regression of fibrosis is not only a function of production of collagens, but that collagen assembly processes are also critical. Tissue transglutaminase (TG2) has been shown to cross-link collagens and other ECM proteins. However, its pathophysiological role has not been demonstrated so far. To address these issues, we are using transgenic mouse strains that express

fluorescent reporters as markers of renal myofibroblastic cell differentiation and collagen I gene activation, and mice that are genetically deficient for TG2. We are using the nonlinear microscopy to track ex vivo and in vivo transgenic myofibroblastic cells and to quantify the density of collagen fibres.
The second project using nonlinear microscopy concerns the interplay between mechanics and genetic and molecular activity during embryo development. More specifically, in collaboration with E. Farge at Institut Curie, we have demonstrated the use of femtosecond pulses to modulate and analyze morphogenetic movements in vivo. We have shown that femtosecond photablation can modulate 3D cell movements of Drosophila gastrulation and shown that the expression of twist, a master regulator gene of embryo morphogenesis, is in turn mechanically induced by tissue deformations.

Last Modification: Mon 21 March 2011

MSc in Engineering

Chimie

Program Language: French

Content:

Since the Second World War, the evolution of chemistry has been quite impressive. New theoretical (DFT, ELF...), synthetic (new reactions...), and analytical tools (X rays, NMR, ESR, mass spectrometry...) have been introduced. New fascinating objects such as fullerenes, carbon nanotubes or high temperature supraconducting materials have been constructed by chemists.

Chemistry will be faced with numerous new challenges in the coming years such a high performance materials, human health, energy resources, and environmental issues. It will be necessary, for example, to find more effective new antiviral drugs (AIDS), new anticancer treatments (epothilone, taxol...), and new antibacterial agents against highly resistant strains.

Program Contents :

années

- Chimie deuxième année : introduction à la chimie sur deux niveaux
- Chimie quatrième année

laboratoires

- Laboratoire "Hétéroéléments et coordination" (DCPH)
- Laboratoire de Synthèse organique (DCSO)
- Laboratoire des Mécanismes Réactionnels (DCMR)

Last Modification: Thu 22 July 2010

MSc in Engineering

Chimie deuxième année : introduction à la chimie sur deux niveaux

Program Language: French

Content:

Chemistry is initialy present in all human activities : food, clothing, housing, transport, health, car, etc…, understanding the language of chemitry is therefore necessary to understand modern society and the various moral, social, political and economics issues facing it.
Two courses are offered to the students : a short initiation course for those not intending to pursue a career in chemistry or related to chemistry and a longer course for those who are specially intersted in chemistry.

Last Modification: Thu 22 July 2010

MSc in Engineering

Chimie quatrième année

Program Language: French

Content:

Chemical Engineering : combined diploma with another school

Exemples of Schools of Engineering :
ENSCP
- Processes and methods of the Chemical Industry
- Chemistry of living organisms and biotechnology
- Chemistry and Radiochemistry (electronuclear industry)
- Process Engineering

Ecole des Pétroles et Moteurs
ESCPI
ENSTA

Graduate courses : Master

Students have opportunity to complete their formation with the multinational Master in " Molecular Chamistry" which received the EEC Label in 19999.
This multinational Master associates professors and students from the universities of Louvain (Belgium), Lausanne, Bern and Geneva (Switzerland), Saarbrück (Germany), Polytechnic Institute of Lisbon (Portugal) with those from Ecole Polytechnique.
It covers three main areas

- Bioorganic and Medicinal Chemistry
- Synthetic Organic Chemistry
- Orgaometallic Chemistry and Catalysis

More specialised courses are given on hetero-elements synthesis, molecular electronics, organic polymers, molecular modelling, catalysis, and structural determination.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire "Hétéroéléments et coordination" (DCPH)

Program Language: French

Content:

Laboratory "Hétéroéléments et coordination"
The "Hétéroéléments et Coordination" laboratory focuses principally upon the interaction of organic molecules ("ligands") with transition metals. Understanding and controlling this interface is of crucial importance to processes as diverse as catalysis, making sophisticated molecular materials, small molecule activation, and preparing metallic nanoparticles. The laboratory specialises in the synthesis of heteroatom (O, N, S, P)- containing ligands which are designed to coordonate and modulate the reactivity of transition metals and lanthanides, and has acquired a worldwide reputation for innovation in te preparation and use of cyclic molecules containing carbon-phosphorus bonds. This area, which became part of chemical mainstream in the 1970's, is now at the forefront of industrial catalyst design.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire de Synthèse organique (DCSO)

Program Language: French

Content:

Organic Synthesis Laboratory

The research undertaken in the Organic Synthesis Laboratory focuses on the discovery of novel reactions and the development of original and efficient strategies for the total synthesis of natural products. The synthetic targets are chosen either for their interesting structures or for their biological activities, and hence their potential applications in human therapeutics : the total synthesis of dolabelide, taxol (an anticancer agent), vinigrol (an anti-hypertensive) and colchicine are in progress ; the total synthesis of 10-norparvulenone (anti-viral) has been completed.

These substances are generally extremely scarce in nature. Their total synthesis is therefore necessary in order to study their properties and applications, but they also constitute a substantial synthetic challenge due to their structural complexity.

This research has stimulated the design of new strategies or reactions to achieve known chemical transformations in a more efficient manner. The elaboration of original reactions, relevant to a wide range of chemical fields, is also an important activity in our laboratories; in particular in the area of free radicals and the chemistry of sulphur, fluorine, and nitro compounds, as well as isocyanides and hydrazones. One of these novel reactions has indeed been developed into a radical polymerisation of unusually wide scope and efficiency. Many of these achievements have been facilitated through collaborations with the pharmaceutical industry (Aventis, Syngenta) and the speciality chemicals and polymer industries (Rhodia).

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MSc in Engineering

Laboratoire des Mécanismes Réactionnels (DCMR)

Program Language: French

Content:

Laboratory of Reaction Mechanisms (DCMR)

The laboratory uses a combination of experimental mass spectrometric techniques, and of intensive computation, to study molecular processes in chemistry and biochemistry. Mass spectrometry is a powerful analytical tool, applicable to all types of molecules, with a spectacular development in recent years in molecular biology. Besides its ability to detect and quantify the components of a mixture, even at the

ultra-trace level, mass spectrometry is also an ideal means to study the thermodynamics, kinetics and mechanism of chemical reactions of molecular ions in the gas phase. It is especially powerful when complemented by molecular modelling. Our research endeavours cover these various facets, from small organic molecules to biological macromolecules, from fundamental studies to applied issues.
Research areas :

- Analysis of biomolecules with ultra-high resolution mass spectrometry : peptides, proteins and their non covalent assemblies
- Interactions of metal cations with biological molecules; modelling of enzyme active sites and catalytic cycles
- Reactivity and thermochemistry of organic ions in the gas phase
- Development of analytical methods of interest in toxicology and environmental sciences ; modelling of combustion processes

Last Modification: Thu 22 July 2010

MSc in Engineering

Economie

Program Language: French

Content:

At the Ecole Polytechnique, teaching in the field of Economics corresponds to the heterogenous expectations of a population of students who have various occupational objectives.
Many students aim at embracing a career as engineers in the industrial world and in such a case they mainly need a broad introduction to the methods of economic analysis as well as courses that focus on corporate issues. However, a growing proportion of the positions offered to the students who leave the Ecole Polytechnique are in economic or financial institutions and, although these students will not fully specialize in economics (at leat at the beginning of their career), they need a strong grounding in the fundamental methods of economics as well as courses that focus on applied economics issues. Lastly, education is also conceived for those who aim at later specializing in economics, for instance at ENSAE, through a master degree or a PhD in economics.

During the first two years at the Ecole Polytechnique, economics courses are devoted to the basic principles of micro and macroeconomics as well as to an introduction to corporate economics. The third year gives an introduction to more advanced issues and it also gives more weight to personal work It particularly includes an internship with a firm, a state or international institution or an academic research center, in France or abroad.

Program Contents :

années

- Economie: les deux premières années
- Economie: troisième année
- Economie: quatrième année professionnalisante

Laboratoires.

- Laboratoire d'économétrie

Last Modification: Thu 22 July 2010

MSc in Engineering

Economie: les deux premières années

Program Language: French

Content:

The courses offered by the Department of Economics in years 1 and 2 are devoted to introducing the main issues of micro and macroeconomics (one course in each year) as well as presenting some topics in econometrics (one course in year 2). Complementary courses are offered by other departments, particulary the HSS Department, with seminars or courses in economic history or about corporate issues.

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MSc in Engineering

Economie: troisième année

Program Language: French

Content:

Le Département d'Economie de l'Ecole Polytechnique propose des enseignements de niveau master 1 qui comprennent :

• Le Master 1 Quantitative Economics and Finance, en coopération avec le département de mathématiques appliquées et HEC.

• Le Master 1 Economics and Public Policy, en coopération avec Sciences Po et l'ENSAE.

Cette première année ouvre la voie sur de nombreuses formations complémentaires tant en France (Master 2 et écoles d'application) qu'à l'étranger (Master en Economie, Management, Finance, Gestion des ressources naturelles et de la technologie…, notamment aux USA ou au Royaume Uni). Ces formations débouchent sur des métiers ayant une composante économique significative dans un cadre privé ou public, national ou international (banques, assurances, conseil, grande entreprise, organismes internationaux, agences de régulation, administration économique, recherche, etc.).
Dans les deux Master 1 le premier trimestre permet de consolider les acquis et d'explorer de nouveaux champs en microéconomie, macroéconomie et économétrie. Le deuxième trimestre permet aux élèves de s'orienter vers des domaines de spécialisation en rapport avec leur projet professionnel. Durant le troisième trimestre, les étudiants effectuent un stage de recherche dans une entreprise, une administration ou un département de recherche, en France ou à l'étranger.

Ces deux Master 1 permettent d'accéder aux Ecoles d'application de l'Ecole Polytechnique. Ils constituent aussi la voie naturelle (et sont de fait fortement recommandés) pour poursuivre dans les Masters 2ième année suivants, proposés par l'Ecole polytechnique en co-habilitation avec d'autres institutions d'enseignements supérieurs :
· Master « Analyse et Politique Economiques (APE) » Spécialité co-habilitée par l'Ecole des Hautes Etudes en Sciences Sociales (EHESS), l'Ecole Nationale de la Statistique et de l'Administration Economique (ENSAE), l'Ecole Normale supérieure (ENS), l'Ecole des Hautes Etudes Commerciales (HEC), l'Ecole Nationale des Ponts et Chaussées (ENPC)
· Master « Economics and Public Policy » : Spécialité co-habilitée avec Sciences Po et l'ENSAE.
· Master « Economics of Markets and Organizations » : Spécialité co-habilitée par l'Université de Toulouse 1 et l'Ecole des Hautes Etudes en Sciences Sociales (EHESS).
· Master « Economie du développement durable de l'énergie et de l'environnement (EDDEE) » : Spécialité co-habilitée par l'Université Paris X-Nanterre, l'Ecole des Hautes Etudes en Sciences Sociales (EHESS), l'Institut National Agronomique de PAris Grignon (INAPG), l'Ecole Nationale Supérieure des Mines de Paris (ENSMP), l'Ecole Nationale du Génie Rural et des Eaux et Forêts (ENGREF), l'Institut National des Sciences et Techniques Nucléaires (INSTN), l'Ecole Nationale Supérieure du Pétrole et des Moteurs (ENSPM), l'Ecole Nationale des Ponts et Chaussées (ENPC).
· Masters Mathématiques de la Modélisation (parcours OJME) et Probabilités et Applications (parcours Probabilités et Finance) du département de Mathématiques appliquées de l'Ecole Polytechnique en co-habilitation avec l'Université Paris VI1.
Ils sont également exigés pour poursuivre une quatrième année à l'ENSAE.

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MSc in Engineering

Economie: quatrième année

professionnalisante

Program Language: French

Content:

After the first three years, students at the Ecole Polytechnique can complete their training and specialize in economics through various channels, including
Partner schools such as ENSAE or ENPC,
a Master's degree in business economics at HEC management school,
a more research focused degree such as a DEA, a Master or a PhD, in a university in France or abroad

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MSc in Engineering

Laboratoire d'économétrie

Program Language: French

Aims:

Econometrics
Principal activities
The laboratory brings together economists, mathematicians, and organization specialists interested in theoric and applied modelization from a microeconomic angle. The laboratory's members mostly belong to the CNRS or Ecole Polytechnique, but some of them also belong to the National Institute of Agronomic Research (INRA) and to different universities (by agreement or association).
The main research fields concern:
Mathematical methods: optimization, game theory;
Economic policy: collective choice, environmental and urban economics, public economics;
Firms and markets: industrial organisation, risk analysis, and crisis management.
For each one of these research fields, the laboratory is in contact with the international scientific community, and collaborates with several foreign universities:
University of Louvain-la-Neuve (CORE),
London School of Economics,

Montreal Cirano
Leontief Center of St-Petersburg,
University of California in Santa Barbara (Department of Applied Probability and Statistics),
University of New York in Stony Brook (Institute for Decision Sciences, founded by a member of the laboratory),
University of Delaware (Disaster Research Center),
University of Cambridge (Department of Land Economics),
University of Dortmund (Institut für Raumplannung),
Universidad de Grenada (Departamento de Mathematica Aplicada),
University of Leiden (Department of Public Administration),
Lincoln Institute of Land Policy (Cambridge, USA),
University of Tokyo (Institute of Social Sciences),
University of Chili in Santiago (Department of Applied Mathematics),
University of Pennsylvania (Wharton Business School),
Hebrew University of Jerusalem (Center for Rationality and Interactive Decision Theory),
University of Tel-Aviv (Department of Mathematics).

Beyond this scientific recognition, most of the laboratory's members do expert evaluations with public and private organizations, such as the World Bank, the OECD, the European Commission, ministries, firms, and professional associations.

The Econometrics Laboratory is a combined unit of the National Center of Scientific Research (CNRS) and Ecole Polytechnique. In the CNRS, it is affiliated to the Department of Human and Social Sciences, as well as to the Department of Engineering Sciences.

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MSc in Engineering

HSS

Program Language: French

Content:

Overall presentation

The Department of Humanities and Social Sciences (HSS), established when the École Polytechnique moved to its current location in Palaiseau in 1976, is in fact the product of a long humanist tradition in the education of Polytechnique students. From the very start of the École Polytechnique in the nineteenth century, the founders always wanted there to be a counterbalance to the traditional technical areas of study, so that in addition to scientific
knowledge, there would also be art, history, and literature, providing a more intuitive sense of how to live in the human world.

It is therefore in a spirit of dialogue and debate, rather than in a spirit of confrontation or opposition, that the Department's has built his curriculum. In no sense do the humanistic courses at Polytechnique deny or reject the precision, provability, or power of the exact sciences, but rather they serve as an invitation to put those sciences in the perspective of the fundamental lessons in human history and society, and in particular to connect science with the personalities and unique creativity of the people who master, develop, and transform it.

It is crucial that the education offered at Polytechnique to future engineers, business executives, researchers, managers, and administrators be integrated, along with scientific knowledge
and techniques, into the repertoire of ideas that lie beyond quantification and mathematization, starting with the major languages and representational systems used by humanity, not only on the global level of cultures and societies, but also on the more local level of business organizations and individuals. As is obvious, such an ambition is far from trivial, and as a consequence, the programs of study offered by the HSS Department are wide and far-ranging. In order to make our offerings as clear and as attractive as possible to our students, we have established, for each semester, three complementary sets of courses in which students have the right to select among lectures (ranging from 60 to 400 students) and seminars (usually numbering between 15 and 30 students). These options are as follows:

(1) the study of economic history, law, and political science, and in addition an introduction to the world of business and management science;

(2) the study of the humanities and the social sciences in the traditional sense of those terms: literature, philosophy, history, sociology, and foreign civilizations, as well as epistemology,
anthropology, ethics, the philosophy of action , and finally cognitive science;

(3) the study of the arts, including studio courses in drawing, painting, sculpting, and printmaking, seminars on the history and philosophy of art, and workshops in architecture and urban design, taking advantage of the most recent developments in CAD and so forth.

These courses and seminars take up roughly half a day per week for the entire duration of a student's time at Polytechnique (one weekly seminar lasting two hours, and one large lecture course lasting 90 minutes). Most are taught by professors in the HSS Department (see
the list of teaching staff), but some take advantage of various connections with eminent researchers and

faculty members from foreign or French universities, or of connections with people from the corporate world. Of course, whenever possible, the HSS Department cosponsors courses with other Departments in the École (most often the Economics Department and the Biology Department), or at times with one or another of the so-called "Grandes Écoles", such as HEC (Hautes Études Commerciales).

Much like the other scientific Departments at Polytechnique, the HSS Department offers research programs to students in their fourth and final year of study, which lead to either the Master's degree or the DEA degree (Diplôme d'études approfondies) in the following areas:

– Management and dynamics of organizations;
– Scientific methods of management;
– The economics of organizations;
– Cognitive science.

To summarize, the HSS Department serves the students of the École Polytechnique not only as a launching pad for their study of the humanities but as a way of deepening man's origins, and as an opportunity to master the spirit of constructive criticism. It is a hallmark of success whenever the HSS Department's teachings lead its students to enrich their scientific understandings by infusing into them those special types of intangible musings and intuitive
shadings centered on values and esthetics that only a humanistic approach can bring -- and indeed, must bring -- to the more hard-edged, objective, and pragmatic worlds of science and technology.

Program Contents :

Laboratoire

- Laboratoire PREG-CRG
- Laboratoire CREA
- Laboratoire CREA-Le Grisé

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire PREG-CRG

PREG-CRG

(Pôle de Recherches en Économie et Gestion -

Centre de Recherche en Gestion)

Director: Christophe Midler

32, bd Victor - 75739 Paris Cedex 15

Phone: 01 46 34 34 09 - Fax : 01 46 34 34 44

crg@polytechnique.fr

Associated to the CECO, the CRG (director: C. Midler) is part of the Economic and Management Research Pole (PREG) (director: PJ Benghozi).
The CRG is formed by 65 people (35 teachers or researchers; 23 doctoral students and 7 administrative officers)

Over the 37 past years, CRG activities have expanded in four research areas.
Research areas
Innovation based competition and design systems dynamics
This research programme aims at developing a general analysis of the current transformations by exploring the variety of form this revolution can take in different sectors and sizes of industries.
(Contact: F. Duboc, C. Midler)
Business Strategies and Market Structure
The research programme aims at analyzing business strategies in the competitive environment and supply chain market arrangements.
The theoretical perspective primarily focuses on providing with an understanding of the dynamics of globalization and market regulation.
(Contact : H. Dumez, A. Jeunemaître)
Telecommunications, Audiovisual Culture and digital technology innovation
This research programme is interested in economics effects. (Intellectual property rights,

competition, public policies) and organizational change (business model, networks, knowledge management, results) linked to NTIC's development (Contact: PJ Benghozi, R. Teulier)

Multicultural approaches in Management Language sciences, models and management tools, created in 2007, focuses on firms 's internationalization Several theorical frames are used to show that: history of the design processes and instutionalization of management practices, among others.

(Contact: D. Bayart, M. Berry, and E. Godelier)

The CRG welcomes students, either for PHD or for Master's Programs.

Masters

– Project, Innovation and Conception (PIC) The general purpose of this Master of Science in Project, Innovation and Design Management is to present and implement this new concepts and theories.

It is open to student from engineering degrees (Polytechnique and Mines cursus) and business schools (Université Marne la Vallée Cursus).

– Engineering and Innovation Technologies – Competitive Strategies track (DOCTIS) (Ecole Polytechnique, Said Business School, University of Oxford). This master focuses on strategy and market regulations issues.

– Network Industries and Digital Economy (IREN) aims to train dynamic students to allow them to master the principles driving network industries

and the digital economy.

PhD Programmes:

PhD in Management: the CRG has devoted important resources to the training of doctoral students. 35 PhD dissertations have been completed. 24 PhD students are currently affiliated with the Centre. Far from being exclusive to the Ecole Polytechnique, the PhD Programme welcomes students from all engineering schools and universities Departments – 79 over the world. The global recruitment benefits to the research, and strengths the international influence of the Ecole Polytechnique.

– Institution Economics and laws (international PhD): Programme is promoted by the Ecole Polytechnique, the Cornell Law School (USA), the Law School and the Centre for Advanced Studies in Law and Economics at the Ghent University (Belgium), and the University of Turin (Italy). Further information at: www.iel-turin.it

Program Language: French

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MSc in Engineering

Laboratoire CREA

Program Language: French

Aims:

CREA
(Research Center for Applied Epistemology)
Director: Paul Bourgine
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Founded in 1982 by Jean-Pierre Dupuy and Jean-Marie Domenach on the initiative of Jean Ullmo, the CREA is the École Polytechnique center of cognitive sciences and epistemology. It became a unité mixte de recherche (UMR) in 1987. Since its origin, its dual objectives address both modeling in the human sciences (self-organization of cognitive as well as economic and social complex systems) and the philosophy of science. Research at the CREA is centered on the various aspects of cognitive sciences, be they individual or social, concerning the study of complex systems and the philosophy of science.

The research is theoretical in the double sense of mathematical modeling (dynamic models, control theory, logic, category theory and topoi) and epistemological discussion. The ties with empirical disciplines (in particular neurosciences, psychophysics, experimental economy and cognitive linguistics) are nevertheless close and formalized via cooperative agreements with other centers.

The research is poly-scientific in the sense that its interdisciplinarity is intrinsic and endogenous. This is imposed by the very nature of cognitive structures as symbolic abstract structures, describable in their own appropriated formal language, yet emerging from underlying complex physical and bio-chemical processes.

The CREA endeavors firstly to technically and epistemologically deepen the transferring of non-trivial dynamic and physical models to the mental and social sphere and to specify their proper cognitive usages.

It also seeks to clarify the particularly difficult problem of synthesis, in a computationally unified framework, of these models with the logical models of mental contents.

Ultimately, the CREA strives on this basis to

“revise” the fundamental principal problems inherited from modern philosophical disciplines (particularly phenomenology).

The CREA rests upon four areas of research, grouped into two domains: Modeling and Epistemology.
On the modeling side, the principal characteristics involve:
– dynamic and logical models of “individual” cognition (models of mental states, processes and contents linked with neurosciences)
and
– the complex models of social cognition and adaptive rationality, even if, with the CREA adopting the principle of methodological individualism for social models, this difference is not a dichotomy.

On the epistemological side, the principal characteristics involve:
– epistemological and fundamental discussions regarding cognitive sciences themselves
and
– the epistemological implications of cognitive sciences for other human sciences and for the foundations of science.
The CREA presents two masters programs:
- Cognitive sciences
http://www.ehess.fr/enseignements/scog/home.html
- Institutional economy
http://www.uparis10.fr/enseignement /deadess/man/segmi_dea_ei_man.htm

Last Modification: Mon 26 July 2010

MSc in Engineering

Laboratoire CREA-Le Grisé

Program Language: French

Aims:

LE GRISÉ
(Group for Research and Innovation in Science and Ethics)
Director: Monique Canto-Sperber
Département HSS
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In 1999, applying a recommendation in the guiding outlines of the École which encourage it to exist as a “place dedicated to discussions and debates on the role of science in our society”, a Group for Research and Innovation in Science and Ethics (GRISÉ) was added to the assemblage of the Research Center infrastructure.

Under the direction of Monique Canto-Sperber, professor of the HSS department, the principal mission of the GRISÉ is to allow, via its research activities, demonstrations and publications, both by students and scientific personnel (professors, researchers et administrators), a reflexive return to the learning and application of the science of observation, especially with regards to ethics and moral philosophy.

During the first three years of its existence, the GRISÉ exercised its expert capacities in such varied themes as the implications of global warming, the coming social, economic, political, and cultural impacts of developing nanotechnology, the issue of the responsibility of scientists and engineers, the ethical problems posed by preimplantation genetic diagnosis, the patentability of life, the representation of violence in the media, the detection and prevention of geopolitical crises and corruption.

These activities and innovations are realized at the request of organizations such as the Institute for Durable Development and International Relations, the Conseil Général des Mines, Stanford University, the National Advisory Committee for Ethics in Life Sciences, the INRA committee for ethics and prevention, the Kriegel commission on violence in the media, and industrial groups such as Thalès and General Motors.

The activities of the GRISÉ are presented within publications (three journals have been published to date, on the principles of prevention, the attacks of September 11th, and bioethics) and fuel gatherings organized at irregular intervals at the Palaiseau campus.

The labors of the GRISÉ to organize and gather around common objectives the quite dispersed community of researchers whose work pertains to these topics are manifested in weekly research seminars which unite on average thirty researchers and students, and serve as a meeting place for foreign researchers passing through Paris.

Last Modification: Mon 26 July 2010

MSc in Engineering

Informatique

Program Language: French

Content:

The principal goal of our teaching is to give a solid grounding in computer science to all the students at the Ecole polytechnique, and also to offer the possibility of specializing in this subject up to research level. The courses cover equally fundamental and essential aspects as well as specialized teaching on the cutting edge of the subject.

Program Contents :

Années

- Informatique: les deux premières années
- Computer Science, Third Year
- Informatique quatrième année

Laboratoire

- Laboratoire LIX

Last Modification: Thu 22 July 2010

MSc in Engineering

Informatique: les deux premières années

Program Language: French

Content:

L'offre de formation en informatique en année 1 et 2 permet d'amener un maximum d'élèves, idéalement tous, jusqu'à ce qui est communément considéré comme le niveau minimum de connaissances en informatique. Omniprésente dans la société, l'économie ou la science, l'informatique se doit d'être maîtrisée par tout ingénieur, quel que soit son domaine. Il est nécessaire de comprendre les problématiques et la complexité des systèmes informatiques. Ceci inclut la compréhension des fondements de l'algorithmique, la programmation et la calculabilité, une connaissance de base du fonctionnement et de l'architecture des réseaux et systèmes informatiques.

Les différents cours de ces deux premières années sont :
- INF 311 : Introduction à l'informatique
- INF 321 : Principes des langages de programmation
- INF 421 : Les bases de la programmation et de l'algorithmique
- INF 422 : Composants d'un système informatique : Introduction à l'architecture des ordinateurs et à leurs systèmes d'exploitation
- INF 423 : Fondements de l'Informatique : Logique, Modèles, Calculs
- INF 431 : Algorithmes, Réseaux, Langages
- INF 441 : Modal d'informatique : Web, Réseaux, Image, Programmation sûre...

En tronc commun (première année) une répartition est faite entre les cours INF311 et INF321, essentiellement selon la filière d'entrée. Le cours INF421 permet aux élèves ayant suivi INF311 de compléter leurs acquis pour leur permettre de suivre les autres formations d'Informatique.

INF422 et INF423 sont deux cours thématiques qui traitent deux aspects complémentaires de l'informatique. INF422, accessible aussi bien aux élèves qui ont suivi INF311+INF421 que ceux qui ont suivi INF321 explore les détails du fonctionnement bas niveau de l'ordinateur et détaille le passage du circuit de silicium aux programmes évolués que l'on connaît aujourd'hui. INF423 expose les fondements des modèles de calcul de l'Informatique.

Le cours long d'informatique, INF431, fournit le socle d'informatique que tout ingénieur ou scientifique doit connaître : modélisation, représentation et traitement de l'information et des programmes, systèmes communicants, paradigmes de la conception d'algorithmes.

Ce cours est le pré-requis général pour accéder à tous les cours d'informatique en année 3.

Le modal d'informatique, INF441 est ouvert à tous. Il permet de découvrir de manière plus pointue certaines technologies clef : la conception d'un site web dynamique, la conception des réseaux, la programmation efficace, la réalité augmentée, l'analyse et la synthèse d'images ou les outils permettant de réaliser des programmes sans bugs.

Last Modification: Thu 17 March 2011

MSc in Engineering

Computer Science, Third Year

Program Language: English & French

Context:

Computers and computing will be included in all future positions of the École polytechnique students, for example: companies management, industrial products development, research projects and so on. In theses positions, they will have to use existing software and conceive new ones.

Aims:

The courses of the 3rd and 4th years - Master level - of the École polytechnique Computer Science Department aim at providing students with tools for understanding the technological shifts in the vast domain of information science and technology that constitute the environment where engineers, civil servants and researchers evolve. The 3rd year consists of four themes that cover most of the large domains of contemporary computer science. The goal of this year is to bring students to learn advanced general knowledge and to start learning their 4th year specialization.

Content:

The programme Computer Science offers 4 themes:

Languages, Proofs, Computation
Algorithms and Optimisation
Image and Geometry
Computer Networking and Security

It leads to a second master year at ENST, ENSIMAG, MPRI or abroad.

The program Systems Modelling aims at presenting methods and concepts used to design and verify large systems based on software. To the computer science main content, this course also adds signal processing and electronics. These particular courses introduce the M2 specialization and especially the embedded systems. It leads the ISIC master second year or to an engineer education.

The program From the Semiconductor to the Computing System is shared with both the Physics Department and the Applied Mathematics Department. It consist in introducing "Electrical Engineering". The main aspects of semi-conductors are taught : material physics, complex formalisms and structure of computer science, components (diodes, transistors...) and microprocessors architecture. Several points highlight the link between advanced technologies and physics. This course also teaches basic knowledge for mixed hardware and software systems design.

The program Bioinformatics is shared with the Biology Department. It takes advantages from both departments.

Last Modification: Wed 23 February 2011

MSc in Engineering

Informatique quatrième année

Program Language: French

Content:

The Department of Computer Science offers the following options (others are possible subject to approval by the Department).
Engineering Track:
ENSEEIHT

ENSIMAG
ENST (Télécom)
ENSTA
Supélec
Supaéro

Research track :
Master co-sponsored by the Ecole Polytechnique:
Parisian master of research in computer science (MPRI)
Other French DEAs in Computer Science.

Professionnal Track:
Master co-sponsored by the Ecole Polytechnique:
Master Design and Management of complex computerized systems programme (COMASIC)

Foreign Education Track:
European Masters degrees: at the EP Lausanne, ETH Zürich, Imperial College Londre, TU Karlsruhe, UPC Barcelona, Technion.
USA Masters degrees: at Berkeley, MIT, Stanford, University of Michigan at Ann Harbor, University of Washington at Seattle, etc.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire LIX

Program Language: French

Aims:

Laboratory LIX, UMR 7161 X-CNRS
Located in the heart of the research center on the Palaiseau campus of Ecole Polytechnique, LIX ("Laboratoire d'Informatique de l'X", UMR X-CNRS) has a hundred members of which half are PhD students and forty are permanent researchers, equally distributed between CNRS, INRIA, and Ecole Polytechnique.
The activities of LIX are organized into three areas: algorithmic, networks, and formal methods.
Among the ten teams housed within the lab, six are INRIA projects that have been with LIX since the creation of PCRI (Common Pole of Research in Informatics) on the Saclay plateau.
A joint team between LIX and LIST at the Atomic Energy Commission has existed prior to the establishment of the RTRA Digiteo that promotes the co-location of its various teams. LIX also hosts the Chair in «Complex Industrial Systems» financed by Thalès. Since LIX collects such a number of projects, the lab has become an essential academic actor in the System@tic Pole of Competitiveness.
LIX has a particular interest in developing competence in the multiple facets of network communications, ranging from the treatment of signals, the coding and routing of communications, the distribution and mobility of computation, and the safety and engineering of protocols.

Since mobile networks will be a central component of the future world of embedded systems, lab members have put a particular stress on the development of reliable and effective communication systems in mobile networks.

The lab is heavily involved in teaching at Ecole Polytechnique and at several Master's programs in the Paris area. LIX has various contractual relationships with public organizations (Ministry of Higher Education and of Research, Directorate General of Armaments, the French Agency for Innovation, INRIA, etc) and with several international organizations.

During the last years, LIX sought to develop collaborations
with the industrial world. In addition
to Thales, LIX has also established connections
Microsoft Research, Hitachi Labs, and NASA.

Last Modification: Mon 26 July 2010

MSc in Engineering

Modern Languages and Communication

Program Language: French

Content:

FRLAN000 Langues, Cultures & Communication Département Langues,
Cultures & Communication L'enseignement des langues vivantes s'intègre
dans l'ensemble des enseignements dispensés par L'École.
L'apprentissage de deux langues vivantes est obligatoire.
Il n'existe pas de distinction entre LV1 et LV2, les exigences et les objectifs
étant les mêmes quelle que soit la langue. Seule subsiste une différence de
coefficients au moment des inscriptions aux examens.
L'étude d'une 3e langue est possible sous certaines conditions (voir Annexe 1).
Neuf langues sont enseignées à l'École allemand, anglais, arabe, chinois, espagnol,
français langue étrangère, italien, japonais, russe. Les objectifs linguistiques
L'enseignement des langues répond à des objectifs précis et repose sur une
progression d¹un semestre à l'autre. À terme, l'apprentissage vise à la maîtrise
d'outils permettant à l'élève, y compris à l'élève débutant, d'évoluer dans le ou les
pays concernés, et de suivre un cours dans une langue étrangère. Il est indissociable,
bien entendu, de l'acquisition de compétences culturelles, y compris dans le cadre des
cours de débutant et cela pendant les trois semestres. Cet apprentissage a
également pour but de permettre aux élèves d'étudier à l'étranger dans le
cadre d'un stage d'option ou de la quatrième année. Il nécessite de la part
de l'élève une forte implication dans le travail personnel et autonome.
Organisation des cours L'enseignement est réparti sur trois semestres de
15 semaines chacun (1er semestre : cours généraux, 2e et 3e semestres :
cours à thèmes/modules). Il y a deux heures hebdomadaires d¹enseignement
par langue et par semestre, soit 90 heures au terme des trois semestres,
à l'exception des langues débutantes dont le volume horaire est de 120 heures en tout
. Les trente heures supplémentaires sont concentrées généralement sur les
premier et deuxième semestres. Les horaires sont fixés par semestre.
La répartition au sein des groupes du premier semestre est liée aux résultats lors

du concours d'entrée ou, à défaut, au nombre d¹années d¹apprentissage avant l'entrée à l'École Polytechnique. Les groupes sont constitués par niveau. Le passage d'un niveau à l'autre est déterminé par les notes obtenues pendant le semestre. On distingue 4 niveaux de Compétence, pour les cours généraux comme pour les modules. Ils reposent sur les critères de progression définis par le cadre européen de référence (grille ALTE): 0 : débutant ou faux débutant 1 : faible 2 : moyen 3 : fort. La nomenclature adoptée à l'X en fonction des semestres (1er, 2ème ou 3ème) est la suivante : 1 ou 2 = débutant ou faux débutant 3 ou 4 = faible 5 ou 6 = moyen 7 ou 8 = fort Les élèves sont regroupés suivant leur niveau, LV1 et LV2 confondus. Les enseignants notent tous leurs élèves sans distinction de LV1 et LV2. L'un des objectifs fixés aux enseignants est d'assurer les conditions d¹une progression pour les élèves. Cet objectif ne peut être atteint qu'à la condition que le travail effectué et les efforts fournis soient satisfaisants de la part de ces derniers. Contenus pédagogiques L'enseignement des langues vivantes à l'Ecole Polytechnique s'appuie sur un programme comprenant l'acquisition de compétences linguistiques et culturelles fondamentales. Il privilégie des méthodes communicatives et interactives sans pour autant négliger l'acquisition des quatre compétences linguistiques. · la compréhension orale · la compréhension écrite · l'expression orale · l'expression écrite 1. Cours généraux du premier semestre. Le premier semestre est consacré à une remise à niveau dans les langues choisies par les élèves. Il ne s'agit pas d'enseigner une langue spécialisée, technique, scientifique ou économique, même si ces domaines peuvent être abordés en fonction des circonstances et de la demande des élèves. Chaque enseignant définit le contenu de son enseignement et ses pratiques en fonction du niveau et de la personnalité du groupe ainsi que du type d'évaluation prévu à la fin du semestre. 2. Cours à thèmes du deuxième et du troisième semestre. Consacrés plus spécifiquement à la découverte plus poussée des champs de civilisation, l'enseignement des langues au deuxième semestre (année 2) et au troisième semestre (année 3) est organisé selon le nombre et le niveau des élèves, pour leurs proposer des cours généralistes pour les niveaux débutant et faible ou des cours à thèmes, « Modules » pour les niveaux moyen et fort. Les grands thèmes abordés dans ces Modules sont : · 2 - la littérature, le théâtre et le cinéma, · 3 - l'histoire et la civilisation · 4 - la communication · 5 - la langue de spécialité 3 Abrégé des contenus. · Allemand La section d'Allemand propose de découvrir le monde germanophone à travers des modules de nature diverse : culture (littérature, musique, cinéma, art), civilisation (histoire, management, conquête de l'espace, questions du 21e siècle), ateliers de création (production de pièces de théâtre, écriture de nouvelles policières, publication d'un journal culturel et de nouvelles, réalisation de courts métrages, joute oratoire). Enseignant Coordonnateur : Daniel ARGELES · Anglais La section d'anglais propose la découverte des pays anglophones à travers le monde par des approches aussi diverses que la musique, le théâtre, la littérature des auteurs britanniques et du Sud des Etats-Unis ou encore la philosophie, la publicité et l'anglais des affaires. L'histoire, la civilisation et la politique rivalisent avec l'humour « British » et la littérature fantastique. Enseignant Coordonnateur : Géraldine RAYMOND · Arabe La section d'Arabe propose un enseignement dans la continuité du cours proposé au premier semestre et dont la problématique couvre divers champs d'investigation : linguistiques, historiques et littéraires. Enseignant Coordonnateur : Jean TARDY · Espagnol La section d'Espagnol propose

d'élargir votre culture et votre connaissance du monde hispanique en choisissant des modules généralistes sur l'actualité espagnole ou latino-américaine (histoire, presse, photos, documentaires) ou des modules thématiques : Littérature, Art, Théâtre, Cinéma (analyse filmique). Enseignant Coordonnateur : Cristina MARINAS · Français Langue Etrangère La section de Français propose l'approche de la culture française au travers de la Littérature et des Arts (cinéma, peinture) par le biais de l'humour, des représentations de la jeunesse, et de l'emploi des mythes dans la société moderne. La poésie, l'architecture, la peinture, le cinéma et la photographie fourniront l'argumentation à la rencontre avec Paris. Enseignant Coordonnateur : Isabelle SCHAFFNER · Chinois La section de Chinois propose un enseignement dans la continuité du cours du premier semestre tout en invitant cette fois les élèves à découvrir la culture chinoise à travers mythes et légendes, dictons et proverbes, théâtre et cinéma, poésie et récits, peinture et calligraphie, musique et chansons, danses et arts martiaux -- exploration du lointain suivie d'un voyage culturel (Tibet, Route de la Soie, Pays natal de Confucius) et accompagné d'un projet créatif. Enseignant Coordonnateur : BAI Gang · Italien La section d'Italien propose plusieurs parcours qui permettent aux élèves de découvrir la culture et la societé italienne en suivant des chemins thématiques très variés et atypiques : théâtre contemporain, « commedia all'italiana », « commedia dell'arte », découverte du roman policier, histoire des Brigate Rosse, approche de l'opéra, histoire de l'art, politique, économie… mafia. Enseignant Coordonnateur : Alessandra CHIODELLI · Japonais La section de Japonais propose un enseignement qui permet de découvrir à la fois la langue et la culture du Japon à travers la maîtrise du japonais à un certain niveau permettant de se débrouiller lors d'un séjour dans le pays pour un stage linguistique ou de contacts humains, et d'acquérir les rudiments de la culture japonaise : histoire, société, littérature, arts (arts floral, calligraphie, origami, musique, théâtre et cinéma, arts martiaux judo, kendo, aikido, etc.). Une rencontre avec un pays, une société, une tradition et une culture qui restent toujours à redécouvrir. Enseignant Coordonnateur : Yoko ISHII · Russe La section de Russe propose un enseignement dans la continuité des cours du premier semestre tout en incitant les élèves à découvrir, à travers le cinéma, le théâtre, les oeuvres littéraires, les articles de presse… la culture russe dans toute la richesse de ses formes et de ses réalisations. Enseignant Coordonnateur : Anastasia FORQUENOT de LA FORTELLE Evaluation. La validation des acquis s'appuie sur deux éléments : le contrôle continu et les examens. Examens internes 1. Le contrôle continu, noté sur 20, prend en compte : · une note de travail, sur 10, correspondant à la présence en cours, à la participation aux travaux, écrits ou sous forme d¹exposé. L¹assiduité est une des composantes majeures de la réussite en langue. Toute absence injustifiée est sanctionnable. · une note de niveau, sur 10, qui évalue le niveau linguistique de l'élève. 2. examen écrit s'appuyant d'une part sur la maîtrise de la syntaxe, et d'autre part, sur un essai portant sur le sujet du cours suivi, à portée culturelle. Examens externes · En Anglais un examen du TOEFL a lieu au courant de la première année. Organisé à l'École Polytechnique, ce test institutionnel a pour objet de mesurer le niveau d'une promotion et de servir de référence au critère de suffisance que le Département et la Direction des Études ont fixé aux élèves, au terme de leur scolarité : le score minimum pour obtenir le diplôme de l' Ecole Polytechnique est de 570 en version papier du TOEFL, 230 en version électronique. Les élèves faibles pourront suivre un cours d¹anglais

à distance pendant leur année de formation humaine et militaire. ·
En Allemand L'École Polytechnique est l'un des centres d¹examens en France
du Goethe Institut, et prépare les élèves qui le souhaitent à quatre niveaux
différents : B1, B2, C1 & C2. L'obtention du certificat C2 dispense les élèves
de tout autre examen pour suivre des cours dans une université allemande,
autrichienne ou suisse. En tant que Centre d'examens, l'École accueille environ
150 candidats par an, dont 60 à 70 viennent de l'extérieur
(ECP, ENSMP, AgroParisTech, ENSCP, ENST, Université Paris VII Jussieu).
Au terme du premier semestre, l'objectif visé est le B1 pour les élèves faibles,
le B2 ou le C1 pour les élèves moyens, le C1 ou le C2 pour les élèves forts,
sachant que le C2 (ZOP) exige une préparation spécifique en cours au premier
semestre. · En Français Langue Etrangère Est organisé le TCF du CIEP.
A l'issue du Tronc Commun, le niveau minimum requis en Français Langue Etrangère (Flé),
est le TCF niveau 3, avec un score minimum de 350 à chaque épreuve
ce qui correspond au niveau intermédiaire entre les niveaux B1 et B2 dans
le Cadre Européen Commun de Référence pour les Langues. Cette exigence
de niveau détermine l'admission définitive en qualité d'élève de l'Ecole Polytechnique
et ce avant le début de la formation scientifique multidisciplinaire. Par ailleurs,
l'Ecole Polytechnique décerne son diplôme sous condition d'obtenir le niveau 5,
avec un score minimum de 500 à chaque épreuve, au TCF de la 3ème année d'études.
· En Espagnol Les élèves qui le souhaitent peuvent passer les examens
de l'Institut Cervantes. · En Chinois Examens de l'HSK : Ces examens,
organisés par le gouvernement chinois, reconnus internationalement
sont accessibles aux élèves qui auront atteint un très bon niveau.
Examens de l'INALCO : organisés à l'Ecole, ils permettent aux élèves
ayant satisfait aux épreuves de s'inscrire en deuxième ou troisième année
de DULCO (Diplôme Universitaire de Langues et Civilisations Orientales.
· En Italien Les élèves qui le souhaitent peuvent passer les examens
officiels CLIP et CILS. · En Japonais Le Test d'Aptitude de Japonais,
organisé par la Fondation du Japon, a lieu tous les ans le premier dimanche
du mois de décembre. Il comporte quatre niveaux, le niveau 4 est exigé pour
les élèves débutants. A l'exception du TOEFL, et du TCF pour les élèves
internationaux, ces différents examens n'ont aucun caractère obligatoire.
La formation à la communication I. Les objectifs Les élèves polytechniciens
sont promis dans leur avenir professionnel à exercer des métiers d'ingénieurs,
de chercheurs, de hauts fonctionnaires ainsi que des responsabilités managériales.
Il leur faut acquérir dans cette perspective, un ensemble d'outils et de
compétences en communication. La formation doit permettre en particulier
à chacun d'entre eux de : · savoir exposer son travail de façon claire, compréhensible
, adaptée à tous, · s'impliquer et s'investir dans son discours, ·
développer ses capacités aux rapports interhumains, dans des situations
professionnelles de communication avec les autres. II. Le programme de formation
Il s'appuie sur une pédagogie empirique et dynamique, renforcée par un
apport théorique indispensable et sous-tendue par une éthique et des
valeurs de respect de la personne. 1/ Pendant le Tronc Commun, les
élèves participent à un séminaire obligatoire « Prendre la parole en public »
(1 journée) Le travail porte sur : le contenu et la forme d'un message oral :
· Adapter l'information · Travailler les distorsions dans la transmission des messages ·
Capter l'auditoire, faciliter la compréhension et la mémorisation la relation induite
par le fait de communiquer : · S'impliquer, s'investir dans son discours, donner son

point de vue · Travailler la qualité de son écoute · Identifier ses représentations mentales et ses valeurs · Prendre en compte l'aspect culturel de toute communication Au cours de ce séminaire, chaque élève doit pouvoir évaluer ses points faibles et ses points forts pour continuer à progresser par une pratique adaptée et personnalisée. 2/ En 2ème année, le travail amorcé sur les enjeux de la communication, est approfondi dans des ateliers centrés sur l'initiation à des outils fondamentaux de management (négociation, conduite de réunion, animation de groupe, etc…)
Ces ateliers sont en prise directe avec les nombreuses expériences vécues ou à vivre par les élèves dans le cadre de leurs activités académiques, associatives, sportives…
Ils doivent permettre à l'élève de se situer dans une trajectoire de futur responsable et de se préparer aux responsabilités de dirigeant, en travaillant sur des aptitudes et des capacités personnelles qui joueront un rôle important lorsqu'il aura intégré le monde du travail. Les ateliers sont optionnels, limités à de petits groupes, et organisés en 3 séquences de 2 heures ; à partir des expériences des élèves, ils sont un lieu d'acquisition d'outils et de méthodes. 3/ Tout au long de la formation, une structure, « Le Point Com. » offre sur rendez-vous, une réponse plus immédiate, individuelle et personnalisée, aux élèves en difficulté ou en recherche de conseil.
Elle répond à des demandes ponctuelles en matière de : · présentation d'un exposé · entraînement pour un oral · travail de groupe plus efficace · animation de réunion · etc… Annexe 1. Prescription 3e Langue Depuis la rentrée 2005 des mesures ont été prises afin de rendre la 3e langue plus prescriptive. Il s¹agit en priorité d¹attirer des élèves motivés en langue, et de s'assurer qu'une 3e langue sera suivie jusqu'à son terme et d'éviter l'attrition au 3e semestre. · Obligation d¹un niveau suffisant dans deux autres langues · Accord préalable du Directeur des Études, afin de s'assurer que l'élève a obtenu des résultats satisfaisants dans les matières scientifiques (résultats validés par des résultats au concours d'entrée, ou, à défaut, par des tests reconnus internationalement) · Rédaction d'une lettre de motivation de la part de l'élève, indiquant clairement qu'il s'engage à poursuivre les trois langues pendant toute la durée du cycle polytechnicien.
· Accord du Président du Département des Langues. Le FRANçAIS Langue Etrangère reste la langue obligatoire et prioritaire pour les élèves internationaux non francophones. L'anglais est, de facto, la langue que tout élève polytechnicien doit maîtriser. Annexe 2. Notation au titre des épreuves classantes :
Année 2 Nature coefficient Contrôle Continu langue 1 5 Contrôle Continu langue 2 4 Examen langue 1 3 Examen langue 2 3 Total 15 Communication orale 2 au titre des épreuves non classantes : Année 3 Nature coefficient Contrôle Continu langue 1 1 Contrôle Continu langue 2 1 Evaluation finale langue 1 1 Evaluation finale langue 2 1 Total 4 Communication orale 1
EN
ES

Last Modification: Thu 22 July 2010

MSc in Engineering

Mathèmatiques appliquées

Program Language: French

Content:

To describe complex scientific problems and to be able to devise solutions requires a language and this language is mathematics. Applied mathematics offers tools for building models, analyzing their mathematical properties and performing numerical simulations, in
various scientific and industrial situations.

Applications are extremely varied: mechanics, applied physics, scientific computations, control of dynamical systems, signal and image processing, financial mathematics, econometrics, statistics to mention a few. Applied mathematics gives an access to engineering careers, as well as many thriving economic sectors such as banking or telecommunications.

Applied mathematics is relevant at all stages of the multidisciplinary curriculum of Ecole Polytechnique. Besides the introduction of new mathematical tools, courses emphasize the modeling of complex problems as well as the use of numerical computations.

Moreover, the research teams of the "Centre de Mathématiques Appliquées" cover most subjects that are taught, and the close interaction with teaching offers students the possibility to carry out a research project.

Program Contents :

Années

- Les bases des Mathématiques Appliquées
- Programme d'Approfondissement de Mathématiques Appliquées
- Mathèmatiques appliquées: quatrième année

Laboratoire

- Laboratoire CMAP

Last Modification: Thu 22 July 2010

MSc in Engineering

Les bases des Mathématiques Appliquées

Program Language: French

Content:

First and second year courses include the basic disciplines of applied mathematics which share the same approach of modeling, mathematical analysis, and numerical simulation. There are two main axes. On the

one hand, scientific computing, numerical analysis, and optimization, on the other hand randomness and its elements of probability and statistics.
In the first year, course MAP 311 ("Stochastics: Introduction to Probability and Stochastic Simulation") is accessible to all students and is an introduction to the basics of probabilities leaning on numerical simulation. In the second year, probabilities or statistics are studied in detail in the short courses MAP 432 or MAP 433; numerical analysis and optimization, fundamentals in the modeling of scientific or industrial problems are studied in MAP 431 and the short course MAP 411.

Last Modification: Thu 22 July 2010

MSc in Engineering

Programme d'Approfondissement de Mathématiques Appliquées

Program Language: French

Content:

Ce programme permet de découvrir en profondeur la démarche des mathématiques appliquées, notamment les étapes de modélisation, d'analyse mathématique, de simulation numérique, et d'interprétation physique des résultats. Les applications proviennent de très nombreux domaines : mécanique, physique, sciences de l'ingénieur, contrôle des systèmes, traitement des signaux et des images, finance de marché, économie, biologie... Les enseignements sont en étroite liaison avec des débouchés importants dans l'industrie, la banque ou les services.

Ce programme combine des enseignements utilisant soit une approche stochastique, soit une approche déterministe, et parfois les deux.

Le PA de Mathématiques Appliquées correspond à une première année de Master (M1).
De ce point de vue, on peut conseiller une présélection de regroupements de cours en fonction du parcours visé en deuxième année de Master (M2) qui peuvent mener aux M2 "EDP et Analyse Numérique", "Optimisation, jeux et modélisation en économie"), etc.

Ces regroupements de cours par parcours ne sont que des indications et les élèves restent libres de choisir leurs cours autrement.

Last Modification: Thu 22 July 2010

MSc in Engineering

Mathèmatiques appliquées: quatrième année

Program Language: French

Content:

Ecole Polytechnique's 4th year corresponds to Master year 2 (M2) and features 3 programs:

MATHEMATICAL MODELING PROGRAM : (4 tracks different tracks)
This program is devoted to training engineers and researchers with a high level in applied mathematics and scientifing computing. Three different programs are proposed.

- "Numerical analysis and P.D.E.'s" (Chair: G. Allaire)
Modeling, partial differential equations, discretization and error analysis, scientific computing, applications in physics, mechanics, image processing, finance, engineering.

- "Optimization, Game Theory, and Economic Modeling" (Chair: S. Sorin / F. Bonnans)
Continuous and combinatorial optimization, game theory, economic modeling.

- "Mathematics, Vision and learning" (Chair: S. Mallat)
Modeling, mathematical and computing techniques applied to vision, perception, learning, signal processing.

-"Mathematics Applied to Biological & Medical Sciences" (Chaire: S. Méléard / B. Perthame)
Course centered on the stochastic and deterministic tools of analysis in simulation and modeling for the life sciences. Proposes a general view of the “continuous” tools and applications, covering questions in fondamental biology and biomedical applications . This track aims to train future researchers in the field of “Mathematiques for biology” and to give insight into the career opportunities in biotechnology.

PROBABILITIES & FINANCE PROGRAM
(Chair: N. El Karoui / N.Touzi)
Probabilities and stochastic calculus applied to finance, modeling and finance, inverse problems in Finance and model calibration, risk assessment, American options: numerical theory and numerical methods, stochastic control and portfolio management, credit risk market, exponentials of Ley processes. The aim of this course is to prepare students for quantitative professions in the market finance field.

PROBABILITIES & RANDOM MODELS PROGRAM
(Chair: S. Méléard)
This program is devoted to giving complete training in modern probabilistic tools and their applications. Brownian motion and stochastic calculus, Markov processes, limit theorems and large deviations, Monte-Carlo methods, network models, ergodic theory, statistical mechanics, random matrices, branching processes and Lévy trees, models in evolutive biology.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire CMAP

Program Language: French

Content:

Centre de Mathématiques Appliquées
(CMAP)
Les activités de recherche du département de
Mathématiques Appliquées sont menées au Centre
de Mathématiques Appliquées (CMAP) qui est une
Unité Mixte de Recherche entre l'X et le CNRS
comprenant environ 45 chercheurs (dont 38 enseignants-chercheurs résidents), 61 doctorants, 11 ingénieurs ou personnels
administratifs, et de l'ordre de 8 chercheurs
invités. Le CMAP accueille aussi trois équipes de
chercheurs de l'INRIA Saclay Ile de France.
Les recherches menées au CMAP sont motivées
par des phénomènes physiques, chimiques, biologiques,
économiques, financiers ou issus du
traitement de l'information. Ces recherches vont de
la théorie abstraite jusqu'à la simulation numérique
effective.
Elles prennent en compte la complexité réelle
des phénomènes et leurs éventuelles caractéristiques
aléatoires. Elles incluent la modélisation,
l'analyse mathématique, l'analyse numérique, le
calcul effectif par ordinateurs et la visualisation des
simulations.
Le CMAP a de multiples contacts nationaux et
internationaux : il fait partie de nombreux GdR
(Groupements de Recherche du CNRS), projets
ANR (Agence Nationale de la Recherche), ERC. Le CMAP a aussi de nombreux contacts
avec l'Industrie et les Services, par exemple avec
le CEA, le CNES, Dassault Electronique, EADS, EDF,
IFP, PSA, Renault, Thalès, Price Waterhouse Cooper,
COFACE, Société Générale Asset Management
(SGAM), et Finance Concepts, en particulier avec
des contrats CIFRE.
Outre les nombreux contrats de recherche du
CMAP, plusieurs chercheurs du CMAP sont consultants
à titre personnel. Trois jeunes entreprises ont

été créées par des chercheurs du CMAP. La société IMACS, créée en 1994 par Toufic Abboud, s'occupe d'acoustique et d'électromagnétisme, la société Let ItWave, créée en 2001 par Stéphane Mallat, s'occupe de compression d'images. La société Finance Concepts, créée par Rama Cont, est spécialisée dans les outils numériques pour la gestion des risques financiers.
Plus de renseignements sur les activités du CMAP (et notamment ses publications et séminaires) peuvent s'obtenir sur son site web :
http://www.cmap.polytechnique.fr

Last Modification: Mon 26 July 2010

MSc in Engineering

Mathèmatiques

Program Language: French

Content:

Courses taught in the Department of Mathematics play an important role in the students' education, either in their own right, because they are linked to very active areas of research, or by virtue of their many links with other scientific disciplines. These interactions, which play an increasingly important role, take place both through applied mathematics, and are linked directly with physics, as well as with computer science and economics.

The program is flexible, and the relations of students to mathematics can be as varied.
Students can choose to study only the mathematics that are essential to twentieth century physics, such as Hilbertian methods and Fourier analysis. Others will prefer to choose electives which cover algebra (group theory, code theory, Galois theory), analysis (the theory of distributions, partial differential equations), geometry and topology, including dynamic systems and general relativity, and a wide range of applications. Of course, all the intermediate cursus are possible.

Program Contents :

Année

- Mathématiques: première annnée : tronc commun
- Mathématique: deuxième année
- Mathématique: troisième année : Programme d'approfondissement et stages de recherche

Laboratoire

Last Modification: Tue 1 March 2011

MSc in Engineering

Mécanique

Program Language: French

Content:

The Mechanics program is designed to present the main concepts and methods underlying the description and understanding of macroscopic phenomena in the Engineering and Natural Sciences. It strives to teach the students how to implement these concepts and methods in order to achieve the optimum design of various mechanical systems or to control their operation. The program involves both theoretical modelling and experimentation and it seeks to make students aware of industrial applications.

Mechanics courses are open to all students: they are organized so as to take into consideration the growing diversity of incoming students' backgrounds and career objectives.

Program Contents :

Année

- Mécanique: deuxième année : les grands concepts
- Mécanique: troisième année de l'X - Première année de Master

Laboratoire

- Laboratoire d'Hydrodynamique (LadHyX)
- Laboratoire LMD
- Laboratoire de Mécanique des Solides (LMS)

Last Modification: Thu 22 July 2010

MSc in Engineering

Mécanique: deuxième année : les grands concepts

Program Language: French

Content:

The objective of second year courses is to introduce the main concepts of the subject, without attempting to be too comprehensive. It seeks to give students a working knowledge of the most general methods. In this second year, a significant portion of the program is already devoted to the implementation of concepts and methods, most notably through the use of numerical simulations and experimentation.

Last Modification: Thu 22 July 2010

MSc in Engineering

Mécanique: troisième année de l'X - Première année de Master

Program Language: French

Content:

The third year of the “Ingénieur”’s program at Ecole Polytechnique corresponds to the first year M1 of the Master’s degree. The Mechanics department then proposes four specialties, all of them built in partnership with other departments.

The objectives of this M1 year is to introduce the fundamental concepts and methods which are essential in order to fully benefit from the more advanced Specialty programs offered in the second year M2. Eligible students should have successfully completed an undergraduate degree in science or engineering.

The M1 programs offered by the department are:
The graduate program in Mechanics
The graduate program in Mechanics and Physics for Environment
The graduate program in Engineering and Innovation Technologies
The graduate program in Energies for the 21st Century

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire d'Hydrodynamique (LadHyX)

Program Language: French

Content:

Ecole Polytechnique – CNRS
www.ladhyx.polytechnique.fr
Director: Jean-Marc Chomaz
chomaz@ladhyx.polytechnique.fr
Deputy-Director: Christophe Clanet
clanet@ladhyx.polytechnique.fr

The Hydrodynamics Laboratory of Ecole Polytechnique (LadHyX) is engaged in theoretical, numerical and experimental research in fundamental fluid dynamics.The research efforts of the laboratory are focussed on the following areas of fluid mechanics: Instabilities and Flow Control; Geophysical Fluid Dynamics; Flow-Structure Interactions and Plant Biomechanics; Microfluidics, Particles and Bubbles; and more recently Soft Matter Physics. In many of these topics, theoretical,
numerical and experimental aspects are synergistically intertwined so as to benefit from a full range of methodological tools. Although most of the research programs are clearly fundamental in nature, they involve flow configurations which
commonly arise in the natural environment and in industrial applications.
The laboratory currently comprises 14 researchers, 6 support staffs, 10 postdoctoral fellows and 22 doctoral students. LadHyX is a partner in numerous contracts and grants from industry in both the private sector (Airbus Industries, Arcelor, Bouygues, EADS, Institut Français du Pétrole, etc.) and in public agencies (Agence Nationale de la Recherche Scientifique, Centre National de la Recherche Scientifique, European Commission, Délégation Générale de l'Armement, INRA, INRIA, ONERA).

The laboratory maintains close collaborations with several international academic establishments in Germany, Canada, China, the USA, Poland, the United Kingdom and Sweden. Its research staff actively participates in the academic programs offered by the department of Mechanics, both at the undergraduate (Ingénieur) and graduate (Masters) levels. The laboratory offers a Master in "Fluid Mechanics, Fundamentals and Applications" in partnership with Université Pierre & Marie Curie. This graduate degree program which is entirely taught in english, attracts highly qualified international students.

Last Modification: Mon 26 July 2010

MSc in Engineering

Laboratoire LMD

Program Language: French

Content:

École Polytechnique
École Normale Supérieure
Université Paris VI - CNRS
www.lmd.polytechnique.fr
Directeur : Vincent Cassé
E-mail : casse@lmd.ens.fr
Directeur adjoint : F. Hourdin
E-mail : hourdin@lmd.jusieu.fr

The Laboratory of Dynamic Meteorology is located on three sites (at the Ecole Polytechnique, at the Ecole Normale Supérieure, and at the University of Paris 6) and is also a laboratory of the CNRS, the leading French research institute. In addition to these four partners, there is the CNES (the French space agency), with which the laboratory maintains privileged links, LMD being one of its spatial laboratories. In total, the LMD employs almost 200 researchers, doctoral fellows, engineers, technicians and administrators, of whom over 100 are permanent staff. Despite its complexity, the LMD is characterised by a strong unity of purpose, since the studies - as its name indicates - concern the dynamics of the atmosphere, and its role in the climate system. It is the study of climatic fluctuations from year to year, on the continental or global scale of atmospheric movements, and the role of human activities in this (greenhouse effect, deforestation), which constitute the prime objectives of studies at the LMD. However, smaller-scale studies, regional and continental, have become increasingly important in the laboratory, as these concern the validation of models based on the analysis of elemental processes, or approaches to new problems and issues, such as the quality of air. The atmosphere constitutes a complex and interactive part of our environment. To study this, the LMD sets up the methods of observation (by satellite or in situ) or complex numerical models. In recent years the laboratory has contributed to important space missions (CALIPSO for the study of clouds, IASI an interferometer for multiple uses for which the laboratory has developed a method of tracking atmospheric CO2).
The LMD is a prime partner for future missions (MEGHA-TROPIQUES, a Franco-Indian space program). It has initiated numerous recent campaigns (AMMA for studying the African monsoon, STRATEOLE to study, by means of balloons, the vortex which allowed the appearance of the ozone hole above the Antarctic, and VASCO in the Indian Ocean). It has contributed, in a significant measure, to modelling studies, which provided the basis for the IPCC report on climate change. This work is not merely experimental, but also incorporates a conceptual and theoretical approach. This is the case when it concerns attempts to understand the fundamental processes (such as the role of stratification, the interactions with the planet's surface and its topography, or the interactions between different scales) or the more heterogeneous processes, often organised on a larger scale (such as the stratospheric circulation, the monsoons, tropical perturbations, or the midlatitudes perturbations). Finally, the atmosphere is also an efficient means of transport, which interacts strongly with the continental and oceanic surfaces, and the study of the atmospheric budgets is in many cases the best method to constrain, for example, the exchanges of water, or the emission of trace gases near the surface. The atmosphere plays a particularly active role in the wider climatic system, which comprises the oceans, the cryosphere, the biosphere, demanding interdisciplinary studies. A federation of laboratories, the Institute Pierre Simon Laplace (IPSL) organised within the Ile-de-France and including LMD, coordinates these studies. An observation site, SIRTA, is run by the LMD at the Ecole Polytechnique for IPSL.

Last Modification: Mon 26 July 2010

MSc in Engineering

Laboratoire de Mécanique des Solides (LMS)

Program Language: French

Content:

Ecole Polytechnique
ENSMP – CNRS
www.lms.polytechnique.fr
Director: Patrick Le Tallec
E-mail : letallec@lms.polytechnique.fr

The research done at the LMS pertains to the mechanics of solids covering all scales in space (from nanometer to terrestrial) and time (from quasistatic to dynamic), studied from a theoretical, experimental and numerical perspective. Researchers at the lab are interested in bridging scales from atomistic to micron to study material behavior at the structural level. They want to understand and quantify the link between their composition, their texture and their mechanical behavior and the presence of different chemical elements.
In addition to these highly coupled problems in the physics of matter, the major part of the lab's research pertains to studies at the macroscopic level of materials, systems and natural or manmade structures. These studies have applications in tranportation, energy production and storage, and in life sciences.

The main research thrusts of the LMS are:
Dynamics, analysis and identification: experiments in the dynamics of materials and structures, identification of mechanical parameters by inverse methods based on experimental measurements, modeling of problems in nonlinear dynamics and associated instabilities.
Fatigue, fracture, contact, interfaces and discontinuities: models to predict fatigue and fracture in structures and processes (e.g. welding);
Geomechanics and Earth Works: thermo-hydromechanical behavior of rocks, micromechanics and local field analyses, methods of change of scale and analysis of relevant mechanisms.
Biomaterials and biomechanics: experimental characterization and modeling of biological tissues and cell mechanics.
With about twenty-five researchers, the LMS contributes significantly to the Ecole Polytechnique's engineering curriculum, its Masters and Doctoral level educational programs. Ten researchers from the LMS are also members of the Ecole's teaching faculty. More than thirty doctoral students do their thesis here at any given time.

Main program Website

www.lms.polytechnique.fr

Last Modification: Wed 23 March 2011

MSc in Engineering

Physique

Program Language: French

Content:

PHYSICS COURSES ON THE CAMPUS OF ECOLE POLYTECHNIQUE

The aim of the courses taught in physics have four main objectives :
1°) Provide the students with a basic scientific culture in modern physics.
2°) Introduce them to the practice of experimentation in the laboratory and to the practice of scientific research.
3°) Prepare them to their subsequent specialized formation either in physics (masters in research) or in technical fields (Engineering institutions).
4°) Make them aware of the many links which relate advanced modern technologies and the progress of basic and applied physics.

The physics courses are taught in two periods :

The first one includes the two first years (cf file PHY300). It is an introduction to the main theories and methods which are the basis of modern physics (quantum and statistical physics, special relativity, variational methods), and to their simplest fields of application. This period also includes an introduction through experiments in the laboratory to a large variety of subjects in physics, materials sciences and modern electronics. Finally, students can also perform, under supervision, a collective project pertaining to physics or electronics.

The third year, organized into two teaching periods and a research training period (cf. file phy 500) includes a more specialized introduction to most major fields of modern physics and of its industrial applications: quantum optics, solid state physics, particle physics, quantum field theory, statistical theory of complex systems, general relativity, astrophysics and planets, geophysics, cross disciplinary subjects (mechanics-physics, biology-physics, chemistry-physics), physics of optical, electronic, and magnetic devices. These courses are a strong basis for further specialized course given in the fourth year (cf file PHY600): research or professional Masters in France or Abroad, Engineering formations.

PHYSICS RESEARCH ON THE CAMPUS OF ECOLE POLYTECHNIQUE

Research in the various fields of physics is strongly developed on the Campus of Ecole Polytechnique !

Nearly all the principal domains of research are present, those which are at the heart of physics, but also fields which are shared with related sciences such as biology, chemistry, (technical) mechanics, computer science and mathematics. Even if the fields of activity belonging to fundamental physics are majority, those directed towards applications are also large in number and presently undergo rapid evolution. The main research interests of the nine Laboratories which are associated with the department of physics of Ecole Polytechnique are briefly resumed below.

We have to add to research institutions which joined the campus recently: L'Institut d'Optique Graduate School (IOTA) and Thalès Research and Technology (TRT). More generally, the Saclay plane (plateau de Saclay) comprises a group of research centres - such as CEA-Saclay, the university Paris-Sud (Orsay) and l'ONERA - of exceptional performancce in physics research and of worldwide importance. These research activities imply obviously numerous international collaborations and cooperations.

The physics department wants to strongly encourage the students of Ecole Polytechnique and all students on the campus to profit at the maximum from this exceptional scientific environment. They should contact as often as possible the research staff in the Laboratories and also their academic teachers, and not only on subjects related to their courses. They will discover science at work, and science on the way to prepare tomorrow's technology !

Program Contents :

Année

- Physique: première année
- Physique: deuxième année
- Physique: troisième année
- Physique: quatrième année

Laboratoires

- Centre de Physique Théorique (CPHT)
- Laboratoire Leprince-Ringuet (LLR)
- Laboratoire de Physique de la Matière Condensée (LPMC)
- Laboratoire de Physique des Interfaces et des Couches Minces (LPICM)
- Laboratoire de Physique des Plasmas (LPP)
- Laboratoire des Solides Irradiés (LSI)
- Laboratoire pour l'Utilisation des Lasers Intenses (LULI)
- Laboratoire d'Optique Appliquée (LOA)
- Laboratoire d'Optique et Biosciences (LOB)

Last Modification: Thu 24 March 2011

MSc in Engineering

Physique: première année

Program Language: French

Content:

Quantum mechanics is the fundamental and complete theory of microscopic structures and processes. All physics is quantum, from elementary particles to stars and the Big bang. Quantum mechanics is certainly one of the greatest intellectual endeavours of mankind. All students follow an introductory course on quantum mechanics. This course has strong cross-references with the courses on mathematics and on

probability theory (PHY311)

Last Modification: Thu 24 March 2011

MSc in Engineering

Physique: deuxième année

Program Language: French

Content:

The second year involves three types of physics courses.
First semester: a two-month course on Relativity and variational principles (PHY431).
Second semester : the main course on Quantum and statistical physics (PHY432).
Second semester: experimental courses called "Modal" (PHY441A-B,442A-B).
Students can also participate in a team work (PSC) on subject of their choice related to basic or applied physics.

Last Modification: Thu 24 March 2011

MSc in Engineering

Physique: troisième année

Program Language: French

Content:

The second part of scientific teaching at Ecole Polytechnique turns from basic to more specialized subjects : the third year is subdivided in three trimesters, Periods 1 and 2 and the subsequent research project (Period 3).
The physics department proposes a catalogue of courses which contains mainly courses in physics but also courses on subjects relating physics to other sciences such as biology, (technical) mechanics, computer science, mathematics and applied mathematics. In addition, there are courses proposed by other departments which give insight into subjects of physical interest from a different point of view.

For those students who have a precise idea on the field of activity they want to study in industry, technology or research (such as energy, environment, theoretical physics, biophysics, electrical engineering etc.), the physics department proposes courses covering the third and fourth years (Master 1 and Master 2). They carry the name of "scientific specialization program" which themselves subdivide into different tracks.
This will help students to find out the courses, research projects and orientation of their fourth years studies which are most adapted to their fields of interest. (If the number of courses recommended in the first or second periods of Master 1 is smaller than the minimal number of courses required, the student will be free to choose courses from other themes related to his field of interest. The four themes of the program "Physics" proposed are described under the website :
http://www.catalogue.polytechnique.fr/programme.php?id=153

Some students could not have completely fixed their personal and professional orientation, or could have a project which is not fully aligned with any of the existing programs/themes. Others would like to discover the methods of modelling or instruments of modern physics in order to use them in some other domain which is their principal field of interest. For all those students, the department of physics makes an offer allowing them to learn what is required for their specialization in the fourth year (Master 2), and to deepen their knowledge of certain fields of modern physics at the same time.
The physics department has organized its teaching program in such a way that the students can follow the courses of the Master 1 program just over one trimester, or over two trimesters, and such that they can choose their research project according to their personal projects.

Most courses proposed are based on the fundamental concepts of microscopic physics taught in the first and second year courses in physics.

The teaching program of Period 1 permits to get acquainted with the great fields of modern physics : quantum optics and lasers, solid state physics, elementary particles, astrophysics and nuclear physics, physics of biological objects, physical origin of mechanical properties, soft matter. In Period 2, students are prepared more specifically to the specialization during the fourth year : Master courses in physics oriented towards research in fundamental physics, material science, optics, geophysics, astrophysics, biophysics, introduction to the physical basis of electronics and industrial optics.

All those tracks comprise also some individual work (in-depth study) on a subject of interest in modern physics. This personal work can be theoretical or experimental. In any case it gives rise to a written report and an oral communication.

Last Modification: Thu 24 March 2011

MSc in Engineering

Physique: quatrième année

Program Language: French

Content:

Partner Graduate Institutes of Engineering
ESPCI
ENSTA
ENST
Mines-Paristech
CEA-INSTN
Pétroles et Moteurs
Supaéro
Supélec
Institut d'Optique Graduate School
Masters in Physics and Applications.
3 possible specialities :
Fundamental concepts in Physics (cf. file PHY 601).
Optics, Matter and Plasmas (cf. file PHY 602).
Materials Sciences and Nano-Objects (cf. file PHY 603).
Masters or PhDs abroad in
Physics
Applied Physics
Electrical Engineering
Aerospace Engineering
Mechanical Engineering
(Universities of Stanford, Berkeley, Caltech, Cornell, UCLA, MIT, Harvard, Yale, Princeton, Karlsruhe, Munich, Zürich, London ...)

Last Modification: Mon 28 March 2011

MSc in Engineering

Centre de Physique Théorique (CPHT)

Program Language: French

Content:

Center for Theoretical Physics (CPHT)
http://www.cpht.polytechnique.fr/

The Center for Theoretical Physics numbers about 70 researchers (half are permanents) whose activity is devoted to the development of theories in various domains of physics. Initially founded by specialists of mathematical physics, the CPHT has varied his interests, with the successive coming of groups of particle physics, of plasmas physics, and more recently of condensed matter physics.
Indeed, one studies in CPHT fundamental interactions, with the help of quantum chromodynamics or string

theory, as well as thermonuclear controlled fusion, in the context of the international project ITER, the theory of chaotic systems, the modelisation of solar flares, the analysis of laser matter interaction with ultra-intense lasers, or the development of modern theories for the computation of electronic structures of strongly correlated materials, to take only a few exemples. A sheet of paper, a pen, a computer, these are the tools of the researchers of the CPHT, in close relation with numerous collaborators operating in laboratories where the theories are compared with the experimental results.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire Leprince-Ringuet (LLR)

Program Language: French

Content:

Laboratoire Leprince-Ringuet (LLR)
http://polywww.in2p3.fr/

The Leprince-Ringuet laboratory has two domains of research which are sharing not only physical concepts but also technical approaches, very high energy gamma astronomy and particle physics. Founded in 1936 at Ecole polytechnique by Louis Leprince-Ringuet, the laboratory was looking at cosmic rays to understand their nature and mostly to study the particles they are made of. Then after a long period of activity on the sole particle accelerators, cosmic rays are again under study at the laboratory, now to understand their sources.
The gamma astronomy looks at the sky through photons of energy around the TeV, thousand billions times more energetic than those from the visible light, a totally new way of observing the sky. The quest is twofold: what mechanisms generate such photons, what are their sources. We use an observatory, HESS, sited in Namibia which detects these photons through their interaction on the nuclei of the atmosphere, the atmospheric Cerenkov telescopes. About fifty sources have been identified,blazars, supernovae, active galaxy nuclei, etc. HESS has received the Descartes prize of the european union. A satellite containing a photon detector of calorimetric type (GLAST) has been launched in 2008. We have built the mechanical structure of this calorimeter. Our activity in particle physics focusses on the strong interactions with the study of the quark-gluon plasma at Brookhaven (NY, USA), state of the universe a little after its creation, on the proton structure at DESY, (Hambourg), on the electroweak physics. Our knowledge of the particles and their interactions is summarised in the so-called "standard model". This model provides excellent predictions but is not really coherent from the theoretical point of view. The most important missing piece is the "Higgs boson" responsible for the mass. It will be actively searched for starting in 2010 by the CERN experiment CMS. in proton-proton collisions, and finely characterised in electron-positron collisions (ILC) by the end of the next decade. These experiments should bring a lot of new physics, may be up to revealing new dimensions of space. We study also with BaBar, close to San Francisco, the particle-antiparticle symmetry. Finally, the oscillations between the three fammilies of neutrinos observed since few years, will

be studied in an experiment in Japan. Our physics has a world-wide development and the experimental installations are scattered all around the world.
Always at the limit of the existing technologies, our field develops its own technologies which can be applied at many other domains. We develop codes for simulating the interactions of particle with matter, or realize beam profilers for the ions accelerators used in cancer therapy. We also prepare the future by looking at new acceleration techniques by plasma in collaboration with other laboratories from the Ecole.

Last Modification: Thu 22 July 2010

MSc in Engineering

Laboratoire de Physique de la Matière Condensée (LPMC)

Program Language: French

Content:

Laboratoire de Physique de la Matière Condensée (LPMC)
http://pmc.polytechnique.fr/

An original aspect of the condensed matter research carried out within the PMC laboratory is that both physicists and chemists collaborate closely on subjects ranging from solid state chemistry and soft matter physics to the elaboration, modification and properties of different materials. More recently, studies at the interface between physics, chemistry and biology have begun to emerge.

From a practical viewpoint, scientists at PMC attack these problems either experimentally, theoretically or via numerical simulations. Of particular note is the tradition of “in-house scientific instrumentation for new science” that has been part of the culture of the laboratory since its creation. A recent and on-going example of this is the construction of a scanning tunnelling microscope capable of producing images of surface magnetism. Typically, projects involve people with diverse scientific backgrounds, either from within the laboratory itself, or via external collaborations. This is best exemplified by the fact that while scientific activity within PMC is organised around four research groups, there are a number of inter-group projects. Fundamental research remains the primary goal at PMC, but at the same time the laboratory maintains a number of applied research projects in collaboration with industrial partners.

The principle scientific theme at PMC concerns the physics and chemistry of condensed matter at the nanoscale. Examples include the fabrication and characterisation of magnetic nanoparticles or nanostructures, the study of fluid flow in disordered or irregular solids and over a large range of length scales, and studies of instabilities at phase transitions or during electrolytic growth. Further information on these and other projects can be found at http://pmc.polytechnique.fr .

PMC attracts a significant number of foreign scientists either as short-to-medium term visitors, as post-doctoral scientists or (most commonly) as Ph.D. students. In total, there are typically about twenty Ph.D. students at any one time at PMC, and these graduates go on to find positions both within the public (research) sector and, most often, in private industry. From a scientific and social viewpoint, students are the lifeblood of PMC (see their website, http://pmc.polytechnique.fr/thesards/).

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MSc in Engineering

Laboratoire de Physique des Interfaces et des Couches Minces (LPICM)

Program Language: French

Content:

Laboratoire de Physique des Interfaces et des Couches Minces (LPICM)
http://www.lpicm.polytechnique.fr/

The research activities of the laboratory deal with the synthesis and applications of thin film and nanomaterials, based on carbon and silicon. These research are devoted both to growth mechanisms and opto-electronical properties. Fundamental aspects of nanomaterial synthesis are investigated. On the other hand, most of the researchs lead to many practical applications, such as large area electronics (solar cells, flat panel displays), molecular electronics and optical instrumentation (ellipsometry…).
More precisely, the research activities of the laboratory cover four different topics :
- Plasma synthesis of silicon based thin films and nanomaterials : influence of growth processes on the electronic properties.
- Applications of silicon thin films to solar cells and flat panel displays (thin film transistors)
- Synthesis and applications of carbon nanotubes and silicon nanowires, in particular biological and chemical nanodetection.
- Optical instrumention in polarimetry. Applications to semiconductor metrology and bio-medicine.

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MSc in Engineering

Laboratoire de Physique des Plasmas (LPP)

Program Language: French

Content:

Laboratoire de Physique des Plasmas (LPP)
http://www.lpp.polytechnique.fr

The Laboratory of Plasma Physics (LPP) was created in January 2009 by the fusion of the Laboratoire de Physique et Technologie des Plasmas (LPTP, CNRS-Ecole Polytechnique) with the Centre d'étude des Environnements Terrestre et Planétaires (CETP, CNRS, UVSQ, UPMC). We pursue research into all fields of plasma physics, from hot to cold plasmas and from laboratory to space plasmas, combining theoretical, simulation and experimental approaches.
Our objective is to make significant contributions to the major contemporary international projects in plasma physics: space plasma research into the sun-earth and other planetary systems, and the ITER project where magnetically confined hot plasmas will be harnessed to achieve controlled nuclear fusion. LPP is also strongly involved with plasma technologies such as plasmas for nano-technology, de-pollution, and plasma sources.
Plasma: the common scientific theme across the laboratory
Whether we are astrophysicists or laboratory physicists, we are all plasmacists. From astrophysics to nanotechnology, our working tool and our research goal is the physics of plasmas. This ionized gas, completely or partially ionized, is the fourth and least known state of matter. At the earth's surface the plasma state rarely exists naturally (lightning is one exception), but a few hundred kilometers overhead is the ionosphere which is a plasma. On the cosmic scale, 99 % of observed matter is ionized and therefore in the plasma state. However, plasmas are also present in a variety of everyday objects, such as fluorescent and low energy lamps and plasma TVs. One should not forget that plasma physics also plays an essential role upstream of a wide range of technological applications: more than half of the processing operations used to manufacture integrated microelectronic circuits such as memory chips are carried out in plasma reactors, and plasma thrusters are considered to be the most promising technology for a manned mission to Mars. Pollution abatement can also be achieved with plasma technologies, along with high power micro-wave and X-ray generation. Finally, plasma physics is essential for the understanding of the different experimental systems implicated in thermonuclear fusion research.
LPP is in position to anticipate, prepare and influence the major international projects in plasma science. The controlled fusion by magnetic confinement project ITER is based on an international treaty between 7 partners (Europe, USA, Russia, Japan, China, Corea, India). For space exploration projects, the instruments built by the group have been selected on most of the space science missions by the space agencies (CNES, ESA, NASA, JAXA (Japan), CNSA (China), IKI (Russia)). The scientists of the group are part of the proposing teams of major programmes of Solar System Plasma Physics: they are preparing the mission BepiColombo toward Mercury, ESA cornerstone mission in collaboration with JAXA (Japan), they will build instruments for Solar Orbiter(ESA/NASA) and for the ESA programme Cosmic Vision (2015-2025), they support the missions Laplace toward Jupiter-Europa and Cross-Scale in the Earth Environment.

Main Research Topics at the LPP
• Magnetic fusion plasma and ITER project
• Space plasma
• Dense plasmas
• Cold plasmas for environment, energy and nanotechnologies

• Theoretical plasma physics
Transverse topics :
• Turbulence in magnetised plasmas
• Space engineering
• Numerical simulations
• Resarch & Technology diagnostics

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MSc in Engineering

Laboratoire des Solides Irradiés (LSI)

Program Language: French

Content:

Laboratoire des Solides Irradiés (LSI)
http://www.lsi.polytechnique.fr/

The Laboratoire des Solides Irradies belongs to three different French research organizations : the Ecole polytechnique, the Atomic Energy Commission (CEA) and the National Center for Scientific Research (CNRS). Its activities, both theoretical and experimental, concern the behavior of solid materials under different types of excitation, including irradiation by energetic particles (electrons, ions), high intensity laser irradiation, or synchrotron radiation.
The "Material Irradiation" thematic deals with the understanding of the microstructural evolution of various materials, particularly those involved in nuclear engineering problems, under irradiation. The laboratory operates an electron irradiation facility which is unique world-wide. We also study the effects of an intense energy deposition by swift heavy ions or accelerated clusters. Other studies concern the radiochemical effects in polymers and radiografting, with various applications to, e.g., Polymer Exchange Membrane Fuel Cells or biomaterials.
Studies on "Laser Solid Interactions" concern the effect of ultrashort high-intensity laser pulses on solid materials, and the investigation through pump-probe methods of the ultrafast electronic kinetics (relaxation, trapping, electronic transfer...) induced by such irradiations in materials. Applications concern the understanding of the laser breakdown of materials and the nanostructuration of dielectric materials using femtosecond laser pulses.
The "Supraconductivity and nanomaterials" team studies the effect of a well controlled induced disorder in high Tc and exotic superconductors on their transport properties and on the thermodynamics of "vortex matter". The development of original local magnetic measurements (magneto-optics, micro-Hall probes...) is a strong activity of this team. On the other hand, the nanofabrication using the "bottom-up" approach of various nanosystems (magnetic or semiconducting nanowires, carbon nanotubes..) and the study of their transport properties, including "nano-spintronics" is a fast growing activity.
Finally, the "Condensed Matter Theory" team applies ab initio calculation methods in a variety of problems

concerning the ground state (structure of transition metal oxydes, of boron-rich materials..) or the excited states (calculation of, e.g., optical absorption, electron energy loss, photoelectron spectra, of non linear optical properties, X-ray inelastic scattering, electron-phonon relaxation...) of many materials. This activity combines the development of front-edge theoretical methods and their applications to practical cases, going all the way to industrial problems. Atomistic simulation of various structures (grain boudaries) or phenomena (atomic mobility or growth processes) using semi-empirical methods, are also under study.

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MSc in Engineering

Laboratoire pour l'Utilisation des Lasers Intenses (LULI)

Program Language: French

Content:

Laboratoire pour l'Utilisation des Lasers Intenses (LULI)
http://www.luli.polytechnique.fr

Research Centre in Plasma Physics, LULI is specialised in the study of laser-generated plasmas and applications. The interaction between high-power laser beams and small targets produces very hot and dense matter, comparable to stars or planet interiors, as well as extremely intense magnetic and electric fields. Relying on these unique assets, LULI's scientific teams develop ambitious programs covering different aspects of hot plasma physics: inertial confinement fusion for energy production, studies on specific astrophysical and geophysical media, acceleration of intense beams of relativistic particles and production of ultra high intensity sources of radiation, fromTHz to gamma-rays.

As a National and European Large Facility, LULI operates the most energetic civil pulsed laser chains in France and the associated experimental infrastructure, and offers access to the international scientific community.

To increase the performances and the competitiveness of its installations, LULI is engaged in a Research and Development program on high-power high-energy laser systems, optics and associated technology.

Member of numerous national and international collaborations, LULI is a training centre for undergraduate and graduate students in the domains of Laser-Generated Plasmas and Applications and Physics and Technology of High-Power Lasers.

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MSc in Engineering

Laboratoire d'Optique Appliquée (LOA)

Program Language: French

Content:

Laboratoire d'Optique Appliquée (LOA)
http://loa.ensta.fr/

Le Laboratoire d'Optique Appliquée (LOA) a pour thème de recherches la production et l'utilisation multidisciplinaire d'impulsions ultra-brèves (quelques femtosecondes (fs), 1fs = 10-15 s), et de forte puissance (jusqu'à 100 TéraWatts = 1014 W). La très forte intensité crête de ces impulsions laser permet l'étude de la matière dans des conditions d'interaction extrêmes. Dans ce nouveau régime dit « relativiste », les effets de la relativité restreinte modifient profondément la dynamique de l'interaction et permettent de créer des sources de particules ou de rayonnements elles-aussi ultra-rapides.
Ainsi les thèmes d'étude au LOA ont trait :

• à la génération d'impulsions ultra brèves, femtosecondes
• l'interaction lumière matière dans le régime ultra intense, relativiste et ultrarelativiste
• faisceaux « laser » dans l'extrême ultra-violet (XUV) ; il s'agit ici d'étendre la physique des lasers aux très courtes longueurs d'onde, en se basant sur un plasma comme milieu amplificateur
• Impulsions attosecondes , également dans l'XUV. La durée typique est de l'ordre de 100 as (10-16 s), soit les impulsions lumineuses les plus rapides jamais créées ;
• Rayons X femtosecondes cohérents ou incohérents. Ces sources permettent peu à peu d'ouvrir à la science des rayons X, longuement étudiée grâce aux synchrotrons, toutes les questions de dynamique de la matière.
• Paquets d'électrons femtosecondes accélérés jusqu'à plusieurs centaines de MégaElectronVolt.

Le LOA est soucieux d'appliquer les impulsions intenses au médical. Deux grandes thèmatiques sont en développement :

• ophtalmologie femtoseconde. Avec le Laboratoire Biotechnologie et Œil du Service d'Ophtalmologie de l'hôpital Hôtel Dieu de Paris il développe un « trépan laser femtoseconde » beaucoup plus précis que le mécanique utilisé à présent. Il est utilisé pour la correction de la myopie, la greffe de la cornée, le glaucome.
• Proton thérapie. Le LOA étudie les sources de protons ou de neutrons pulsés accélérés résultant de l'interaction laser-plasma, pour le traitement du cancer.

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MSc in Engineering

Laboratoire d'Optique et Biosciences (LOB)

Program Language: French

Content:

Laboratoire d'Optique et Biosciences (LOB)
(également associé au département de Biologie)
http://www.lob.polytechnique.fr/

Le Laboratoire d'Optique et Biosciences (LOB) est une structure mixte (Ecole Polytechnique – INSERM – CNRS) rassemblant en un seul site des compétences en biologie moléculaire et cellulaire, en optique et en dynamique femtoseconde, dans le but de développer des synergies au-delà des thématiques propres à chaque spécialité. Il s'agit ainsi de favoriser l'émergence de nouveaux concepts et outils, en particulier pour la compréhension du fonctionnement des protéines et de leur organisation au sein des cellules et tissus.

Les thèmes abordés au laboratoire portent notamment sur l'étude de la dynamique des protéines à l'échelle femtoseconde. Le principe général de ces expériences repose sur l'excitation par une impulsion femtoseconde d'une réaction biochimique dont l'évolution ultérieure est observée à l'aide de différentes méthodes résolues en temps comme la spectroscopie visible ou infrarouge, la spectroscopie multidimensionnelle cohérente, le dichroïsme circulaire, ou la diffraction de rayons X. Un autre axe du laboratoire concerne le développement de nouvelles approches d'imagerie d'organismes biologiques, utilisant soit le suivi de biomolécules individuelles soit des processus d'optique non-linéaire comme par exemple la génération d'harmoniques ou la fluorescence par absorption multiphotonique.
Les chercheurs du laboratoire contribuent en outre à l'enseignement à l'Ecole Polytechnique dans les départements de physique et de biologie, et interviennent également dans différents masters.

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