ParisTech
INSTITUT DES SCIENCES ET TECHNOLOGIES
PARIS INSTITUTE OF TECHNOLOGY

MSc in Engineering

IngÃ©nieur ESPCI

Program Language: French

Aims:
Lâ€™ESPCI forme des ingÃ©nieurs possÃ©dant une large culture scientifique pour lâ€™innovation et la recherche industrielles.

Content:
Les deux premiÃ¨res annÃ©es Ã lâ€™Ã‰cole sont destinÃ©es Ã donner aux Ã©lÃ¨ves une solide formation de base aussi bien en physique quâ€™en chimie et en biologie, et Ã acquÃ©rir la maÃ®trise des mÃ©thodes mathÃ©matiques, informatiques et numÃ©riques nÃ©cessaires Ã lâ€™ingÃ©nieur.

La troisiÃ¨me annÃ©e, qui est une annÃ©e de perfectionnement, de stages industriels et de projets de recherche en laboratoire, dÃ©bute par le stage industriel obligatoire, dâ€™une durÃ©e de 4 Ã 6 mois, dans de grandes entreprises ou en PME/PMI. Plus de la moitiÃ© de ces stages se dÃ©roulent Ã lâ€™Ã©tranger, dans les pays europÃ©ens, mais aussi aux Etats-Unis, au Japon, en Australieâ€¦ A leur retour de stage, les Ã©lÃ¨ves choisissent entre trois dominantes physique, chimie ou physico-chimie. Au sein de chaque dominante, coexistent des cours communs et des cours Ã option, oÃ¹ un choix est offert (option I). Les cours dâ€™option II, pour leur part, sont ouverts aux trois dominantes, et constituent souvent lâ€™amorce dâ€™une spÃ©cialisation. Les Ã©lÃ¨ves mÃ¨nent ensuite un projet de recherche individuel de 10 semaines Ã temps complet prÃ©fÃ©rentiellement dans un laboratoire de lâ€™Ã‰cole.

En quatriÃ¨me annÃ©e, les Ã©lÃ¨ves rejoignent les cursus universitaires classiques en France ou Ã lâ€™Ã©tranger (masters, puis, Ã©ventuellement, thÃ¨se de doctorat) ou, encore, complÃ¨tent leur formation dans diverses Ã©coles dâ€™application (mastÃ¨res pour ingÃ©nieurs). Cette annÃ©e de spÃ©cialisation, avec une trÃ¨s large plage de choix possible, apporte une compÃ©tence dans un domaine particulier ou un complÃ©ment de formation et peut Ãªtre considÃ©rÃ©e comme un Â« sur-diplÃ´me Â» trÃ¨s apprÃ©ciÃ© des futurs employeurs.

Admission:
L'admission dans le cycle ingÃ©nieur se fait :
- par concours sur la filiÃ¨re PC des classes prÃ©paratoires (concours commun avec l'Ecole Polytechnique)
- par concours sur la filiÃ¨re BCPST des classes prÃ©paratoires
- sur titres (licence universitaire de sciences et technologie)

Main program Website
http://www.espci.fr

- ESPCI 1Ã¨re annÃ©e
- ESPCI 2Ã¨me annÃ©e
- ESPCI 3Ã¨me annÃ©e
- ESPCI 4Ã¨me annÃ©e

MSc in Engineering

ESPCI 1Ã¨re annÃ©e

Program Language: French

- Biochemistry/Cell biology
- Quantum Physics
- Statistical mechanics: methods and applications
- Communication and social relations

Last Modification: Tue 15 November 2005

BIO Biochemistry/Cell biology

Lectures: 24 h - Tutorials: 8 h - Preceptorship: 8 h - Laboratory sessions: 38 h
ObjectifsBasic concepts of biochemistry, molecular and cellular biology and current challenges in these disciplines. Introduction to the major classes of biomolecules (sugars, lipids, nucleic acids and proteins), biological catalysis, signal transduction, energy transformation, information storage and replication by genes, and how genes code for RNAs (transcription) which in turn code for proteins (translation). Introduction to the concept of mechanotransduction and its implication for tissue engineering.

Syllabus
Basic concepts of biochemistry, molecular and cellular biology and current challenges in these disciplines. Introduction to the major classes of biomolecules (sugars, lipids, nucleic acids and proteins), biological catalysis, signal transduction, energy transformation, information storage and replication by genes, and how genes code for RNAs (transcription) which in turn code for proteins (translation). Introduction to the concept of mechanotransduction and its implication for tissue engineering.
TutorialsBioinformatics: data banks, DNA and protein sequence analysis.
PreceptorshipArticle analysis: central dogma of molecular biology / membranes / cell and its environment / biotechnology.
Laboratory sessionsCloning and expression of green fluorescent protein (GFP).

Requirements
None.

Evaluation mechanism
Course: written exam (course questions + article analysis). TP report of experiments.

Teaching coordinator : Pascale Dupuis-Williams, Andrew Griffiths, Yann Verdier
Term : core curriculum
Number of hours : 78
ECTS Credits : 6
Last Modification : Wednesday 31 May 2017

PQ Quantum Physics

Lectures: 25 h - Tutorials: 7 h - Preceptorship: 8 h
ObjectifsThe goal of this course is to introduce the fundamental principles of quantum physics, which are needed to understand the theoretical and experimental basis of modern science and technology including materials science, electronics, quantum chemistry, quantum engineering, nanotechnology and photonics. The course emphasizes conceptual understanding but also relies on the necessary amount of mathematical formalism, which is essential for understanding quantum mechanics. Numerous examples of practical use of quantum mechanics are given during the lectures and are studied in more details in preceptorship sessions. Tutorial classes allow the students to put into practice the concepts seen during the lectures.

Syllabus
Introduction to quantum physics
Waves mechanics
General formalism of quantum Mechanics
The postulates of quantum mechanics
Perturbation theories
Harmonic oscillator
Angular Momentum
Hydrogen atom
Addition of two angular momentums
Quantum statistics
Tutorials
Rectangular potential barrier, the infinite and finite quantum wells
The parity operator
Application of the measurement postulate
Harmonic oscillator with a stationary perturbation and with a time-dependent perturbation
Spin in a rotating frame, Nuclear Magnetic Resonance
Interaction between two spins
Addition of two spins
Preceptorship
Preceptorship sessions will deal with numerous areas of contemporary physics, both fundamental and applied, where quantum mechanics plays a major role.
Wave-particle duality. Application to matter probes and to atom-scale optics.
Colour centres in ionic crystals (F-centres).
WKB method. Application to the tunnel effect and the Gamow alpha emission model.
Formation of interstellar molecular hydrogen.
Neutron interferometry. Application to spin rotation and gravitational effect.
Factorisable quantum states, entangled quantum states. Application to quantum cryptography and to principles of qubit teleportation.
The NH3 MASER.
Zeeman effet and Stark effect on hydrogen atom.
Superconducting quantum bit.

Requirements

Classical physics: mechanics and electromagnetism. Mathematics: vector spaces, matrices, differential equations.

Evaluation mechanism

Written examination.

Teaching coordinator : Nicolas Bergeal, ChÃ©ryl Palma
Term : core curriculum
Number of hours : 40
ECTS Credits : 3
Last Modification : Wednesday 31 May 2017

PSA Statistical mechanics: methods and applications

Lectures: 30 h - Tutorials: 15 h - Laboratory sessions: 45 h
ObjectivesThis course is an introduction to the general ideas of statistical physics. Particular attention is paid to basic concepts (entropy, temperature) and to pertinent methods used in other disciplines. We will discuss classical examples (e.g perfect gas, paramagnetism, elasticity of polymers) along with the physics of phase transitions and collective phenomena and quantum statistics. We will attempt to maintain a (difficult) balance between an intuitive approach to phenomena and more rigorous calculation.

Syllabus
Introduction and basic thermodynamics
Probability and random walks
Statistical physics of isolated systems: microcanonical ensemble
Statistical physics at constant temperature: canonical ensemble
Statistical physics of classical systems with no interactions
Ideal quantum gases
Phase transitions, mean field approximations
Langevin equation and fluctuation-dissipation theorem
Laboratory sessions
Emulsion
4 main experiments are proposed to the students :
Solide-gaz phase diagram, sorting based on depletion mechanism
Metastable systems, drainage, coalescence, Oswald ripening
Absorption of a surfactant at a liquid-air interface
Measurement of the chemical activity of salted water
These four experimental cases are good examples of the importance of the interfaces in divided matter.

Simulation and analysis of the thermodynamical properties of hard spheres and hard disks
In this lab, we explore some of the consequences of the atomist hypothesis, by studying, for a hard spheres system, the equation of state of the gaz and its phase transitions, the Brownian motion of a macromolecule, and the depletion interaction between two macromolecules. We use numerical simulations whose results are analyzed with programs written in Python.

Phase transitions of simple liquid and polymers observed by differential scanning calorimetry (DSC)
Experimental approach of the glass transition of polymers
Liquid-crystal phase transition in confined geometry : fusion and crystallization of water

Requirements
A knowledge of Classical thermodynamics and of basic mathematics are required for this course

Evaluation mechanism

Lectures: written exam; lab sessions: mark for the involvement in the session + mark on a written report to be delivered 15 days after the end of the sessions.

Teaching coordinator : Annie Colin, Anthony Maggs, HÃ©lÃ¨ne Montes
Term : core curriculum
Number of hours : 90
ECTS Credits : 7,5
Last Modification : Wednesday 06 September 2017

CRS1 Communication and social relations

Workshops: 15 h
ObjectivesThe main objectives of this first module are:
Discover the main functions within a company
Discover the meaning of social relations within a company
Understand the managerial relationship
Establish students' career plans and provide a clearer idea of their responsibilities as future managers (entitlements and obligations)
How to work with Human Resources

Syllabus
Company position in the French economic market
Company organisation
HR position in the company and relationship with engineers
Recruitment process
Learn to write covering letters and resume
The sessions include case studies, simulations and active student participation.

Teaching coordinator : Brigitte Beaussart
Term : core curriculum
Number of hours : 15
ECTS Credits : 1
Last Modification : Friday 10 March 2017

MSc in Engineering

ESPCI 2Ã¨me annÃ©e

Program Language: French

- Physiology
- Crystalline Materials
- Chemistry and inorganic materials
- Colloids

- Analytical Sciences
- Introduction to polymer physics
- Waves and Acoustics
- Mechanics of solids and materials II
- Professional project

Last Modification: Tue 15 November 2005

PHY Physiology

Lectures: 14 h - Preceptorship: 6 h - Laboratory sessions: 30 h
ObjectivesThe main objective of the course and the associated lab sessions is to present basic notions of physiology (such as homeostasis, neuro-endocrine signaling, retroaction), building up on the molecular and cell biology covered during the first year. The temporal dimension of the organism, conferred by biological clocks that rhythm our days and nights, will be briefly described. It will be developed further in the module "Le temps" of the 2nd PSL exchange week.

SyllabusGeneral organization of the lectures:
Physiology : from molecule to organism in its environment
Introduction to intercellular signaling
An example of neuro-endocrine pathway : from the retina to the synthesis of melatonin (the "night hormone")
Introduction to the cardio-vascular system
Sleep, a physiological state in search of a function

Preceptorship Study of scientific articles on the following themes:
Study of cerebral function through the use of novel technologies (ontogenetic, voltage-sensitive dye imaging, ultrafast ultrasound imaging).
Underlying mechanisms of sleep
Neuroscience article in relationship with NMR
Laboratory sessionsStudy of the human heart through ECG. This double lab session (7.5h) involves both simulation and experimental work.
Study of the regulation of glycemia (involves both simulation and experimental work)
Study of arterial blood pressure (experimental work)
Two methods to study hearing deficiencies : acoustic oto-emissions and auditory evoked potentials (experimental work)
Neurosciences : membrane properties, channels and neuronal activation (simulation)
Brain machine interfaces (experimental work)

Teaching coordinator : AndrÃ© Klarsfeld, Sophie Pezet, Thierry Gallopin
Term : core curriculum
Number of hours : 50
ECTS Credits : 4
Last Modification : Thursday 02 March 2017

MC Crystalline Materials

Lectures: 17 h - Tutorials: 8 h - Preceptorship: 2 h - Laboratory sessions: 44 h
ObjectivesThe objective of this course is to provide students with the basic tools to describe the structure and properties of crystalline materials. The course starts by the crystallographic description of crystalline matter and the presentation of associated characterisation techniques. The second part focuses on the structure of ionic crystals and the deviations from a perfect crystal, in order to understand the relationships between crystalline solid structure and physical properties

Syllabus
Solid state crystal: periodic lattices - symmetries- point symmetry groups and space groups
X-ray crystallography: reciprocal network - structure factor - structure resolutions - diffuse diffusion - experimental methods
Crystal structures: ionic and covalent crystals
Point defects - extended defects - ionic conductivity
Disorder in crystals
Quasicrystals
Structure/property relationship: Curie principle
Piezoelectric and ferroelectric materials
Tutorials
Structure, properties and synthesis of perovskites
Local atomic structure in glass oxides
solids electrolytes
metallurgy
characterization of disordered materials by X-ray diffusion
Laboratory sessions
This course also includes a practical section on the synthesis of crystalline solid materials (ceramics for electronics, mesoporous silica by sol-gel procedure, zeolites, ferrofluid, gold plasmonic nanoparticles and quantum dots) and characterisation of the materials synthesised (X-ray diffraction on monocrystal and powder, scanning electron microscope, BET, electric, magnetic and optical techniques).

Requirements
Group theory - Fourier transform

Evaluation mechanism
written examination: multiple choice problem and general problem

Teaching coordinator : Nicolas Lequeux, Sandrine Ithurria
Term : core curriculum
Number of hours : 71
ECTS Credits : 4.5
Last Modification : Tuesday 28 March 2017

CMI Chemistry and inorganic materials

Lectures: 28 h - Tutorials: 4 h - Preceptorship: 8 h - Laboratory sessions: 42 h
ObjectivesThe basic concepts of inorganic chemistry are exposed by the study of applications that use materials with specific optic, magnetic, electronic or catalytic properties. The molecular and collective aspects are treated in parallel. The progress made in synthetic chemistry and in the understanding of properties enable the development of new materials and new applications.

Syllabus
Optical properties
Crystalline field and gems
Luminescence and lasers
Electronic properties
Charge transfer and light-emitting diode
Crystalline defects and silver halide photography
Semiconductors and p-n junctions
Magnetic properties
Molecular magnetism and Prussian blue
Lanthanides
Synthesis and reactivity
Soft chemistry and inorganic polymerization
Substitution chemistry vs electronic transfer chemistry
Isomerisms and characterisations
Organometallic chemistry and catalysis
Chemical bonding (F. Volatron)
Inorganic complexes
Symmetry and nature of ligands
Tutorials
Ligand Field Theory
Solgel Chemistry
Reactivity
Organometallic Chemistry
Preceptorship
Tanabe-Sugano Diagrams
Lanthanides and luminescence
Organometallic Chemistry and Catalysis
Identification of Inorganic Compounds
Laboratory sessions
Four subjects directly related to the course are proposed. They allow an in-depth study of the basic notions while demonstrating the usefulness of chemistry and inorganic materials in modern and sometimes daily applications.
Ligand Field Theory: Cobalt rainbow; complex alcohol tester ; mordanting
V2O5 gel: solgel chemistry; electrochromic cell; semiconducting transparent electrodes
Photography: cyanotype, Prussian blue, electrochromic window, argentic photography
Light Emitting Diode with [Ru(bpy)3]2+ and Europium phosphor

Requirements

Synthesis, cristallography, electrochemistry, spectrocopies (IV-visible, NMR, IR).

Evaluation mechanism

part A (1hr): post-lab examination, no document (8/20); part B (2 hrs): problem with document (12/20); chemical bonding (0.5 hr): problem without document (0-3 pts bonus).

Teaching coordinator : Sophie Norvez, Corinne SouliÃ©, FranÃ§ois Volatron, Renaud NicolaÃ¿
Term : core curriculum
Number of hours : 82
ECTS Credits : 5,5
Last Modification : Friday 22 February 2019

COL Colloids

Lectures: 18 h
Objectives
Colloids are objects of intermediate size (mesoscopic), between 10-8 m and 10-6 m. Colloids consist of a highly divided material state in which interfaces have a predominant role. Such systems are very common in everyday life. Examples include liquid or solid sprays (mists or vapours), foams, emulsions such as milk, mayonnaise, cosmetic creams, suspensions such as Indian ink, paints, drilling mud, catalyst or ceramic precursors. The industrial scope of these system is extremely diverse and is characterised by close coupling between product synthesis, formulation and functionalisation. As a general rule, colloidal systems are relatively unstable systems in which a precarious equilibrium between various antagonistic forces is observed. The purpose of this course is to introduce this discipline in the third-year chemistry option. The aim is to present the main categories of colloids, discuss the various interactions structuring these systems and study the main strategies for stabilising and/or destabilising these "colloidal phases". This course draws on and uses knowledge acquired from other courses in the college, giving examples of application. It makes it possible to introduce some problems encountered in the fields of materials, speciality chemistry, pharmaceuticals, cosmetics, paints and coatings, water-based binders.

Syllabus
Systems at equilibrium
General introduction to liquid condensed matter
Molecular interactions
Pure liquids and phase diagram
Solutions of amphiphilic molecules
Surface and interfacial tension of solutions
Wetting and detergency
Metastable states
Dispersions
Emulsions
Gels

Teaching coordinator : JÃ©rÃ´me Bibette
Term : core curriculum
Number of hours : 18
ECTS Credits : 2
Last Modification : Friday 10 February 2017

SAN Analytical Sciences

Lectures : 10 h - Tutorials: 6 h - Preceptorship: 6 h - Laboratory sessions: 45 h
ObjectivesThere is practically no socio-economic or scientific field that can do without the contribution of analytical chemistry (food safety, environment, fraud and counterfeit, doping, historical and archaeological heritage). The characteristics of the demand are: speed, low cost, reliability, possibility to perform tests from microsamples (drop of blood, etc.), use in the field, determination of a large number of compounds from the same sample (oil products, proteomics), test of trace and ultra-trace amounts of compounds, speciation of elements, etc. Analytical chemistry has evolved greatly in the last few years to be able to respond to these demands, partly thanks to technological advances in particular in the field of separation sciences and their coupling with mass spectrometry, but also thanks to the increasing development of bioanalytical chemistry with the use of biological tools (antibodies, receptors, enzymes, DNA strands, etc.) in various immunoassays, bioassays and biosensors. We have also seen a miniaturisation of analytical techniques, which allows faster analyses and consumes less reagents and solvents for fast diagnosis. Lab-on-chips (LOCs) are in full development and use microfluids.This course is intended to provide students with the basic knowledge required for solving an analytical problem, irrespective of the source of the request. It also aims at providing the concepts necessary for the development of new methodologies, often miniaturised, a sector which is currently undergoing large-scale expansion in the field of medical and environmental diagnosis.It starts with the study of various types of interactions and interface transport methods. Irrespective of the information sought about a chemical substance (concentration, structure, chemical state, prediction of its transport or elimination, etc.) and the nature of the milieu in which it is found (chemical, biochemical, biological), the design of an analytical strategy always requires good knowledge of the interactions that bind this substance to its own milieu and in most cases the use of a separation method. The fundamental aspects of separation methods and analytical electrochemistry are then briefly presented as they are examined more thoroughly in the tutorial sessions, while their practical aspects are approached in the laboratory course. This allows more importance to be given to the use of multi-dimensional separations for the analysis of complex mixtures and in particular for proteomic analysis, to bioanalytical chemistry (immunoassays, bioassays, biosensors) and the miniaturisation as lab-on-chips.

Syllabus
Definition of the characteristics of current analytical chemistry
Separation sciences
Introduction to chromatographic methods: fundamental magnitudes and various interactions used
Gas chromatography.
Liquid chromatography (the different modes: adsorption, partitioning, ion exchange)
Detection modes and coupling with mass spectrometry
Electrokinetic methods (free capillary, micellar phase, electro-chromatography)
Trace analysis: sample treatment
Two-dimensional coupling for the separation of complex mixtures (chromatography, electrophoresis) - applications to the analysis of oil products and proteomic analysis
Electrochemistry
Fundamental aspects
Analytical electrochemistry
Bioanalytical methods
Based on structural recognition: immunoassays
Based on the mode of action: enzyme inhibition bioassays and cellular bioassays
Miniaturisation: integrated separation microsystems and lab-on-chip for total analysis
Biosensors
Tutorials
Fundamentals and Optimization
Gaz chromatography
Miniaturization in LC, Adsorption Chromatography

Partition Chromatography
Ionic Chromatography/ Size exclusion
Capillary electrophoresis
Preceptorship
Supercritical fluid chromatography, advantages-drawnbacks/interest compared with GC and LC + an article dealing with fast separations (use and interpretation of "kinetic plots")
Simple ion exchange chromatography and interest of coupled chemical reactions for selectivity, ion pair chromatography + an article about hydrophilic interaction chromatography (HILIC)
Electrophoretic miscrosystems + a presentation of the students on a research thematic proposed by each preceptor (GCxGC, LCxLC, sample handling...)
Laboratory sessions
The four week laboratory course enables hands-on experience of the different methods such as gas and liquid chromatography, electrophoresis and electrochemistry. These methods teach the fundamental magnitudes and different techniques (separation, detection, various coupled methods) enabling their implementation. The treatment of the sample associated with liquid chromatography and gas chromatography is also used on examples such as the analysis of pesticide traces in surface water and the characterisation of volatile compounds in wine.
The students will carry out fifteen different experiments during this lab course. In general, each experiment deals with a specific case, besides the more theoretical aspect of the method, of the characterisation/analysis of compounds from varied fields such as the environment, food industry, pharmaceutical and oil industry.
It is important to note that the students use the latest generation material if possible (example of liquid chromatography and mass spectrometry coupling) so that they are subsequently quickly operational both in an industrial setting and in research.

Requirements
Basic analytical chemistry (aqueous solutions, pH, complexes, redox systems).

Evaluation mechanism
Examination on the course, report for pratical works.

Teaching coordinator : JÃ©rome Vial, JosÃ© Dugay
Term : core curriculum
Number of hours : 67
ECTS Credits : 7
Last Modification : Wednesday 31 May 2017

IPP Introduction to polymer physics

Lectures: 20 h - Preceptorship: 6 h
ObjectivesThis course deals with the statistical physics approach to the study of polymers properties with an emphasis on strengthening intuitive understanding. The aim is to offer the students a good intuition for the system, the length scales, and the time scales.

Syllabus
We focus on the ideas, mechanisms, driving forces, understanding of competing interactions. Then, we develop simple calculations which are almost always compared to experiments for verification.
Entropy of polymer chains (in relation with the Statistical mechanics module)

Intrinsic dimensions of a polymer chain (ideal/real, stretched/confined, measurement of size by scattering
Polymer blend and polymer solution (free energy of a binary mixture: entropy vs enthalpy, exclude volume concept for polymer solutions: chain size and correlation length in good solvent)
Rubber elasticity (affine network model and its limits, swelling properties of a polymer
Dynamics of conformational changes
Thermal energy /energy of weak interactions (van der Waals, H bonds...)
Time of measurement/ time of conformational changes
Different length scales: i) chain diffusion : motions of an entangled chain (example of the reptation) ; ii) glass transition: motions at length scales from the KÃ¼hn segment to the entanglement distance ; iii) characteristic times of chain rearrangement & mechanical perturbation: temperature and time dependence of the modulus E*(T, w) , viscoelasticity and time temperature equivalence, WLF law.
Preceptorship
Dimensions of a chain: conformations and properties in solution
Vitreous transition
Rubber elasticity
Links to other course modules
The concepts are presented in relation to other courses: Statistical mechanics, Optics, Mechanics of solids and materials II and Crystalline materials.

Requirements
Stress-strain response of visco-elastic solids ; thermodynamics : entropy, internal enregy, statistic of a random walk ; short range interactions : Van der Waals, H bond, etc. ; thermodynamics of binary mixtures ; conformations and configurations of a polymer chain.

Evaluation mechanism
Exam written in English in 2 parts (answers in English or French allowed): part I, 10 concept questions; part II, 5 short problems.

Teaching coordinator : HÃ©lÃ¨ne Montes
Term : core curriculum
Number of hours : 26
ECTS Credits : 2,5
Last Modification : Thursday 07 September 2017

OA Waves and Acoustics

Lectures: 19 h - Tutorials: 6 h - Preceptorship: 4 h - Laboratory sessions: 45 h
Objectives
This course aims to give a thorough grounding in the tools necessary for describing wave propagation. We propose a unified framework based on the idea that in spite of their diversity all waves obey a differential equation with the same symmetry properties: invariance under time-translation, spatial reciprocity, time-reversal invariance.

A special focus is made in acoustic waves propagating in various kinds of fluids (homogeneous, heterogeneous, bounded). Laboratory sessions, tutorials and preceptorships give the opportunity to address important issues for industry (medical imaging, non destructive testing, sonar,...) as well as more academic ones (e.g., sonoluminescence).

Syllabus
Introduction
How to build a wave ?
Wave equation and diffusion equation
Acoustic waves in fluids
Generation of acoustic waves in a fluid
Conservation laws and the equation of state
Linear acoustics
Nonlinear acoustics
Diffraction theory
Unicity theorem
The spatio-temporal Green's function
The monochromatic Green's function
Reciprocity theorem
The Helmholtz Kirchhoff integral theorem for monochromatic waves
The Helmholtz Kirchhoff integral theorem in the time domain
Wave propagation and signal theory
Diffraction as a spatial filter
Fresnel transforms and Fourier transforms
A lens as a spatial matched filter
Radar and sonar pulse compression
Tutorials
Acoustic waveguide
Diffraction impulse response of a circular transducer
Passive imaging based on noise correlation
Preceptorship
The concept of coherence in wave physics
Time Reversal of ultrasound in disordered media and wireless communications
Laboratory sessions
Ultrasound imaging
Wave propagation in complex media
Sonoluminescence
Links with other courses
Electromagnetic waves (1st year)
Mathematical methods II (2nd year)
Optics (2nd year)
Waves in Complex Media (3rd year)

Requirements

Fourier Transform

Operators : gradient, divergence, curl, Laplacian.

Evaluation mechanism

Written exam (2h30). Laboratory notebook.

Teaching coordinator : Arnaud Tourin, Fabrice Lemoult
Term : core curriculum
Number of hours : 74
ECTS Credits : 6

Last Modification : Tuesday 28 February 2017

MSM2 Mechanics of solids and materials II

Lectures: 18 h - Tutorials: 6 h - Preceptorship: 4 h
ObjectivesThis course in the Mechanics of Solids is oriented towards the mechanical properties of materials. After some revision of the fundamental concepts of stress, deformation and elastic energy (treated in the 1st year classes), we will develop the principal types of behavior showing their physical origins. Viscoelastic and plastic characteristics, and fracture of large classes of materials are considered in parallel with a study of the corresponding constitutive equations which govern their behavior. A study of simple solicitations will lead to ideas guiding the choice of a particular material depending on the application envisaged (e.g. structure and loading). A methodology with reduced formalism will be employed to address the physical modeling of more complex situations encountered in everyday life or in modern applications.

Syllabus
General notions on material strength and continuum mechanics
Classes of materials and constitutive behaviors
Solution of 3D elastic problems (stress and energy approaches, scaling laws)
Elastodynamics: waves, vibrations, shocks
Viscoelastic behavior: rheological models, time and frequency representations, polymers
Plastic behavior: 1D models, strain hardening functions
3D yield criteria and flow rule
Linear elastic fracture mechanics (stress and energy approaches)
Brittle and ductile fracture : mechanisms of energy dissipation
Contact, adhesion and friction
Instabilities and morphogenesis
TutorialsExercises from previous years exams will be addressed to get a proper training to the final exam.
PreceptorshipNovel topics are developed every year to get acquainted with scaling methods and to treat advanced topics going beyond the main core of the course.
Links to other course modulesIn the frame of the laboratory sessions of the Fluids mechanics course, 4 experiments are dedicated to solids:
measuring the stress field around a crack tip
beam vibrations
delamination of thin films
elastoplastic behavior of glassy polymers

Requirements

Fundamentals of continuum mechanics and linear elasticity (Mechanics of solids and materials I course).

Evaluation mechanism

Written examination (part A: MCQ, part B: exercices based on scaling methods).

Teaching coordinator : Matteo Ciccotti, JosÃ© Bico, Pascal Kurowski
Term : core curriculum
Number of hours : 28
ECTS Credits : 4,5
Last Modification : Thursday 01 June 2017

CRS2 Professional project

Workshops: 12 h
ObjectivesThe main objectives of this second module are:
Know how to assert your career plan while mastering recruitment techniques/processes
Get a better understanding of individual motivations within a team of co-workers in an organisation
Understand certain mechanisms of cooperation within a team towards a common goal
Learn to work with people with different personalities and cultures
Learn to step back and reflect on your own integration in a team

SyllabusRecruitment process: how to find an internship, how to write a covering letter and a resume, on-line application process, etc.
Personal skill assessment, work on the professional project and the skills necessary for the chosen orientation
The sessions include case studies, simulations and active student participation.

Teaching coordinator : Brigitte Beaussart
Term : core curriculum
Number of hours : 12
ECTS Credits : 1
Last Modification : Saturday 25 February 2017

MSc in Engineering

ESPCI 3Ã¨me annÃ©e

Program Language: French

Aims:

La troisiÃ¨me annÃ©e est une annÃ©e de spÃ©cialisation et d'initiation Ã la recherche commenÃ§ant par un stage industriel de 4 Ã 6 mois, suivi par des enseignements scientifiques en trois dominantes : physique, chimie ou physico-chimie. Les enseignements magistraux sont complÃ©tÃ©s un stage en laboratoire de 10 semaines Ã temps plein.

- ESPCI 3Ã¨me annÃ©e Tronc Commun
- ESPCI 3Ã¨me annÃ©e Option Chimie
- ESPCI 3Ã¨me annÃ©e Option Physique
- ESPCI 3Ã¨me annÃ©e Option Physico-Chimie

Last Modification: Wed 16 November 2005

MSc in Engineering

ESPCI 3Ã¨me annÃ©e Tronc Commun

Program Language: French

- Corporate finance fundamentals

Last Modification: Fri 26 June 2009

FF3 Corporate finance fundamentals

Lectures: 12 h - Tutorials: 2 h
ObjectivesUnderstand and analyze corporale P&L and Balance Sheet statements. Link between P&L and B/S - Free Cash Flow. Notions of assets valorization and investment decisions making.

Syllabus
Profit & Loss (EBIT, EBITDA)
Notions concerning the Balance Sheet (essentially working capital)
Links between P&L and B/S and Free Cash Flow
NPV (Net Present Value of an asset)
TutorialsSimple examples.

Requirements
Basic mathematics (algebra, analysis); mass and energy balance.

Evaluation mechanism
Home examination.

Term : core curriculum
Number of hours : 14
ECTS Credits : 1,5
Last Modification : Wednesday 31 May 2017

MSc in Engineering

ESPCI 3Ã¨me annÃ©e Option Chimie

Program Language: French

Content:

- Quatre cours obligatoires :
SynthÃ¨se organique (3 ECTS)
SynthÃ¨se des polymÃ¨res (1,5 ECTS)
RÃ©activitÃ© (1,5 ECTS)
ChimiomÃ©trie (1,5 ECTS)

- Des cours de spÃ©cialitÃ© Ã choisir parmi :
RhÃ©ologie (1 ECTS)
Chimie Inorganique AvancÃ©e (2 ECTS)
SynthÃ¨se Organique AvancÃ©e (3 ECTS)
Biophysique (1,5 ECTS)
Biochimie (1,5 ECTS)

- Des cours d'option Ã choisir (pour un total compris entre 3 et 4,5 ECTS) parmi :
Microfluidique (3 ECTS)
Introduction au GÃ©nie NuclÃ©aire, (3 ECST)
TÃ©lÃ©coms AvancÃ©s (1.5 ECTS)
Physique des composants microÃ©lectronique (1.5 ECTS)
Environnement et dÃ©veloppement Durables, (1.5 ECTS)
Etats ColloÃ¯daux et Bio-colloÃ¯des, (1.5 ECTS)
Biotransformation et gÃ©nie des procÃ©dÃ©s (1.5 ECTS)
ou
GÃ©nie Chimique (option 2 mutualisÃ©e avec lâ€™ENSCP) (2 ECTS)

- un Â« enseignement dâ€™ouverture Â» au choix parmi les modules suivants qui sont ouverts Ã toutes les dominantes : (5 ECTS)
Chimie Fine et Biologie
SystÃ¨mes Ã©nergÃ©tiques
Informatique
MatÃ©riaux sur mesures (option mutualisÃ©e avec lâ€™X)
MÃ©thodes et Instrumentation pour imagerie mÃ©dicale
RelativitÃ© et ElectromagnÃ©tisme

Program Contents :

- Advanced selective organic synthesis
- Polymer chemistry
- Advanced inorganic chemistry
- Synthetic methods in molecular chemistry
- Molecular biotechnology
- Microfluidics
- Colloidal Matter and Biomolecules
- External courses: ENSCP_OPT_GC2 (Link to ParisTech)
- Advanced materials
- Medical imaging: from measurements to images

Last Modification: Tue 30 June 2009

ASOS Advanced selective organic synthesis

Lectures : 20 h - Tutorials: 4 h
ObjectivesFine organic chemistry is everywhere, in medicinal products, perfumes, cosmetics, materials, etc. Knowing the bases of organic synthesis is essential for a chemist.This course is intended for chemists and aims to introduce them to the new reactions used in organic synthesis, for example. This work is applied in the study of major syntheses of biologically active products. These studies additionally constitute a first relative approach to Organic Chemistry synthesis strategies.

Syllabus
Chemoselective alkylation reactions
Organocatalytic reactions
Organometallic coupling reactions
Metathesis and applications
Organometallic coupling reactions with palladium, iron and copper
Catalytic oxydation and reduction reactions
Functional group interconversions
Radical reactions
Rearrangement reactions
Aromatic and non-aromatic heterocycle syntheses

Requirements
To have mastered the first year CHO module

Evaluation mechanism
Written exam with course questions and problems

Teaching coordinator : Amandine GuÃ©rinot, Christophe Meyer, VÃ©ronique Bellosta, Domingo Gomez-pardo
Term : biotechnologies option
Number of hours : 24
ECTS Credits : 4
Last Modification : Saturday 08 December 2018

CP Polymer chemistry

Lectures: 12 h - Tutorials: 4 h
ObjectivesThis course aims at providing the concepts and tools used in macromolecular engineering to design and prepare polymers at will.
To this aim, the general characteristics of the two main polymerization families are presented, i.e. chain growth and step growth polymerizations, and the most significant examples of each family are discussed in great details, namely radical polymerization and polycondensation, respectively.
The concepts presented during lectures and tutorials (synthetic methodology, structure/reactivity relationship, reaction mechanisms, kinetics, polymerization processes) should allow for the rational design

and synthesis of polymers while taking into accounts structural parameters such as molar masses, dispersity, composition, topology and functionality.

Syllabus
Introduction
Thermoplastics / Thermosets
Chain-growth polymerization / Step-growth polymerization
Few properties of polymers
Macromolecular engineering
Radical polymerization
Structure/reactivity relationship
Elementary steps
Initiation
Propagation
Termination
Transfer and telomerization
Degree of polymerization
Copolymerization
Controlled radical polymerization
Concepts and characteristics
Nitroxide-mediated radical polymerization (NMP)
Atom transfer radical polymerization (ATRP)
Reversible addition-fragmentation chain-transfer polymerization (RAFT)
Radical polymerization processes
Bulk polymerization
Solution polymerization
Suspension polymerization
Emulsion polymerization
Step-growth polymerization
Degree of polymerization
Molar masses and molecular weight distribution
Gel point and networks
Kinetics of step-growth polymerizations
Main families of polymers obtained by polycondensation and polyaddition
Macromolecular engineering
Molar masses and molecular weight distribution
Composition: copolymers
Topology: grafted polymers
Topology: branched polymers
Topology: dendrimers
Functionality: chemical modification
Tutorials
Radical and controlled radical polymerizations
Polycondensation and polyaddition

Requirements
Basic concepts in organic chemistry.

Evaluation mechanism
Written examination.

Teaching coordinator : Renaud NicolaÃ¿
Term : core curriculum
Number of hours : 16
ECTS Credits : 2
Last Modification : Monday 05 June 2017

CIA Advanced inorganic chemistry

Lectures: 12 h
ObjectivesMore than 80% of manufacturing processes include at least one catalysed reaction. Catalysis generally makes it possible to reduce costs (energy, separation, reprocessing, etc.) and limit the use of toxic and hazardous materials. The economic and environmental stakes are thus obvious.
In order to thoroughly understand the phenomena involved, the course presents the different types of catalysis through the study of major industrial processes and basic living cycles.
The problems related to the performance and optimisation of a catalytic system, its cost and environmental impact are highlighted and explained via a mechanistic kinetic approach.
The course is based on the knowledge acquired in the second year in Chemistry and Inorganic materials.

Syllabus
Industrial catalysis
Catalysis: fundamental concepts
Catalysis and major industrial processes
Heterogeneous catalysis mechanisms and kinetics
Heterogeneous catalytic system performances
Biocatalysis
Elements of the biosphere
Acidic catalysis, zinc enzyme
Redox catalysis
Industrial processes using biocatalysts

Requirements
Basics of Inorganic and organometallic chemistries, basics of homogeneous catalysis.

Evaluation mechanism
Two homeworks (biocatalysis + homogeneous and heterogenous catalyses) based upon a scientific paper.

Teaching coordinator : Corinne SouliÃ©, Sophie Norvez
Term : chemistry option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Friday 22 February 2019

SMMC Synthetic methods in molecular chemistry

Lectures: 16 h - Tutorials: 4 h

ObjectivesThe goal of this course is to illustrate how the understanding of the reactivity of organic compounds at the molecular level is essential for the design and elaboration of simple to more complex molecular architectures, which can find applications in various domains (biology, material science...). The course will focus on important chemoselective synthetic tools in organic chemistry, fundamental operations including oxidation and reduction reactions, functional group interconversions, as well as strategies for the formation of carbon-carbon or carbon-heteroatom bonds. The key contribution of heteroelements main group organometallic chemistry and transition metal-catalysis to the field of organic synthesis will be outlined. Selected applications in polymer chemistry, drug discovery, medicinal chemistry and chemical biology will be presented.

Syllabus
Introduction
Oxidation
Alcohols oxidation
Epoxidation
Dihydroxylation, oxidative cleavage
Beckmann rearrangement
Baeyer-Villiger rearrangement
Functional groups interconversion
Conversion of alcohols into sulfonate esters and halides
Nucleophilic substitutions
Mitsunobu reaction
Acid derivatives interconversion (esterification, amidation)
Reductions
Reductive agents
Acid derivatives and nitriles reduction
Aldehydes and ketones reduction
Reduction of alpha,beta unsaturated aldehydes and ketones
Stereoselective reduction (Felkin-Anh, Cram-chelate models)
Reductive amination
Halides reduction
Radical deoxygenation and decarboxylation
Alkenes and alkynes reduction
Main group organometallic chemistry
Synthesis and reactivity of Grignard reagents and organolithium reagents
Synthesis and reactivity of organozinc reagents
Synthesis and reactivity of organocuprates
Palladium-catalyzed cross-coupling reactions
Catalytic cycle and elementary steps
Suzuki-Miyaura cross-coupling
Sonogashira cross-coupling
Hartwig-Buchwald cross-coupling

Requirements

A knowledge of the fundamentals of organic chemistry is required. The student should be aware of the basic reactivity profiles of the most important functional groups in organic synthesis (alkenes, alkynes, carbonyl compounds, carboxylic acid derivatives) and be able to write reasonable mechanisms.

Evaluation mechanism

Written exam with course questions and problems

Teaching coordinator : Renaud NicolaÃ¿, Amandine GuÃ©rinot, Christophe Meyer, VÃ©ronique Bellosta
Term : chemistry option
Number of hours : 14
ECTS Credits : 1,5
Last Modification : Saturday 08 December 2018

BTM Molecular biotechnology

Lectures: 12 h - Tutorials: 5 h
ObjectivesUnderstanding of state-of-the art methods in biotechnology and their application for fundamental and applied research.

SyllabusThe lectures will cover state-of-the-art recombinant DNA techniques, including:
amplification
cloning
synthesis
sequencing (including next-generation sequencing)
mutagenesis (directed and random)
recombination
targeted genome editing (e.g. using CRISPR/Cas9)
overexpression of recombinant proteins
screening and selection
directed evolution
These techniques will be exemplified by presenting a number of important applications of molecular biotechnology:
protein engineering for fundamental studies and industrial applications of enzymes
protein engineering for therapeutic applications (e.g. therapeutic antibodies)
engineering of diagnostic systems
engineering of vaccines
TutorialsAssistance with group projects to prepare a short educational course (Powerpoint) to be presented to the rest of the class (15 min presentation + 5 min for questions).

Requirements

Basic knowledge of biochemistry/molecular biology.

Evaluation mechanism

Two hour written exam (70% of marks) + group project (30% of marks).

Teaching coordinator : Andrew Griffiths
Term : biotechnologies option
Number of hours : 17
ECTS Credits : 2
Last Modification : Monday 12 June 2017

MIF Microfluidics

Lectures: 12 h - Preceptorship: 6 h
ObjectivesThe aim is to introduce students to the multidisciplinary realm of microfluidics. The course includes a general introduction to microsystems, MEMS, the "lab on a chip", DNA chips, etc. We will explain how the equilibria of "ordinary" systems are upset by miniaturisation. We will then concentrate on flow in microsystems, and the phenomena of adsorption, dispersion and separation in microfluidic systems. There will follow a description of electrokinetic phenomena, often exploited in microsystems for fluid transport or molecular separation. Finally, at an elementary level, we will present the current microfabrication techniques based on silicon or other materials which enable microsystems to be built.

Syllabus
General introduction to microsystems
The physics of miniaturisation
Flow in microsystems
Adsorption and mixing phenomena; applications to separation in microsystems
Electrokinetic phenomena: electro-osmosis, electrophoresis, dielectrophoresis
Introduction to microfabrication techniques
Preceptorship
Analysis of an article and demonstration of the corresponding experiment, for example:
Analysis of a chemical reaction in a microchannel
Breakup of droplets in a microchannel
Structure of microdroplets in a microchannel

Requirements
Basics of physics, hydrodynamics, biology, physico-chemistry.

Evaluation mechanism
Written exam based on an article study given before to the students.

Teaching coordinator : Patrick Tabeling
Term : core curriculum
Number of hours : 18
ECTS Credits : 2
Last Modification : Wednesday 31 May 2017

COB Colloidal Matter and Biomolecules

Lectures: 11 h
ObjectivesThis course deals with the dynamics and the microscopic behaviour of colloids and more particularly bioactive colloids, such as proteins, enzymes and antibodies. The three first parts are theoretical and provide methods to rationalize and model interacting systems with specificity and catalysis. The last part describes how the evolution of the colloidal science has been exploited to design new health diagnostic devices from the 20th century to the last discoveries and strategies currently developed by start-ups.

SyllabusKey question that are adressed in this course are:
How do colloids diffuse in their environment via Brownian motion?
How do biomolecules and colloids react and associateÂ in a complex medium? How can we model the

interactions between a ligand and a receptor on cell membranes?
What are the dynamics of dissociation of bio-complexesÂ and how can we study the properties of these associations?
How to apply colloidal science to medical diagnostic

Requirements
Diffusion, chemical kinetics.

Evaluation mechanism
Written examination.

Teaching coordinator : JÃ©rÃ´me Bibette
Term : physical chemistry option
Number of hours : 11
ECTS Credits : 1,5
Last Modification : Monday 10 July 2017

MA Advanced materials

Lectures: 24h - Visit of a Saint-Gobain plant: one day
ObjectivesThe objective of this conference series in English is to give an opportunity to the students to learn about research activities in academics or industry in the field of materials sciences.

SyllabusThis series of lectures is common with Ecole Polytechnique students within the activities of the Saint-Gobain/Ecole Polytechnique/ESPCI Chair. It consists in a series of 8 lectures (3 hours) given by professors in various fields of materials sciences. In addition a visit of a Saint-Gobain plant is scheduled for a one day trip.

The program changes every year, below is the 2017 program:E. WimmerÂ (Materials design): ab initio numerical simulations to predict materials properties
U. Steiner (EPFL): photonic materials obtained by self assembly
P. Van Mechelen (ABB corp): Hydrogen transport in materials
J.-M. TarasconÂ (CollÃ¨ge de France): 20 years of development of materials for batteries
P. Ohashi (NIMS, Japan): Challenges in materials sciences for energy and sustainable development
K. Scrivener (EPFL): Cementitious materials, green chemistry in action
A. Saint-Jalmes (Institut Physique de Rennes): physics and chemistry challenges involved in the stabilization of aqueous foams
S. Granick (Korean center for basic research): For those who are bored with thermodynamics: physics of active colloids
Visit of Sully Saint-Gobain plant: production of glass for aeronautics industry

Evaluation mechanism
Summary of the conferences and personal literature review on a topic related to one of the conferences.

Term : physical chemistry option
Number of hours : 30
ECTS Credits : 4
Last Modification : Thursday 23 February 2017

IM Medical imaging: from measurements to images

Lectures: 18 h
ObjectivesTo understand image formation from measured signals.

SyllabusThe first part of the course deals with routine imaging techniques (MRI, ultrasound, CT). The second part introduces more recent techniques, some of which still being the topic of very active research fields (elastography, photoacoustic imaging, optical nanoscopy).

Requirements
Fourier Transform. Bases on acoustic and electromagnetic wave propagation.

Evaluation mechanism
Personal homework, either based on documents to read or problems to illustrate with matlab code. Choice left to each students (amonst 3 articles or 3 problems to code).

Teaching coordinator : Emmanuel Bossy
Term : physics option
Number of hours : 18
ECTS Credits : 3
Last Modification : Tuesday 30 May 2017

MSc in Engineering

ESPCI 3Ã¨me annÃ©e Option Physique

Program Language: French

Content:

- Trois cours obligatoires : Physique du solide, physique de la mesure, apprentissage statistique.

- Deux cours de spÃ©cialitÃ© Ã choisir parmi :
    Biophysique
    Ondes en milieux complexes
    Introduction Ã la CFD

- Cours d'option Ã choisir (pour un total compris entre 3 et 4,5 ECTS) parmi :
Microfluidique (3 ECTS)
Introduction au GÃ©nie NuclÃ©aire, (3 ECST)
TÃ©lÃ©coms AvancÃ©s (1.5 ECTS)
Physique des composants microÃ©lectronique (1.5 ECTS)
Environnement et dÃ©veloppement Durables, (1.5 ECTS)
Etats ColloÃ¯daux et Bio-colloÃ¯des, (1.5 ECTS)
Biotransformation et gÃ©nie des procÃ©dÃ©s (1.5 ECTS)
ou

GÃ©nie Chimique (option 2 mutualisÃ©e avec lâ€™ENSCP) (2 ECTS)

- un Â« enseignement dâ€™ouverture Â» au choix parmi les modules suivants qui sont ouverts Ã toutes les dominantes : (5 ECTS)
Chimie Fine et Biologie
SystÃ¨mes Ã©nergÃ©tiques
Informatique
MatÃ©riaux sur mesures (option mutualisÃ©e avec lâ€™X)
MÃ©thodes et Instrumentation pour imagerie mÃ©dicale
RelativitÃ© et ElectromagnÃ©tisme

Program Contents :

- Solid State Physics
- Physics of measurement
- Waves in complex media
- Microfluidics
- Colloidal Matter and Biomolecules
- External courses: ENSCP_OPT_GC2 (Link to ParisTech)
- Advanced materials
- Medical imaging: from measurements to images

Last Modification: Tue 30 June 2009

PS3 Solid State Physics

Lectures: 18 h
ObjectivesWhen we seek to describe the electrical, magnetic, optical or thermal behaviour of solids, taking into account the large number of atoms per unit volume, it is not possible to carry out a precise analysis based on the behaviour of each atom.
Solid state physics makes it possible to construct models which, when experimentally verified, may be considered as representative.
The formalism constructed to this end has numerous applications. Examples in diverse fields and which sometimes appear to be far removed from solid state physics will be given.

Syllabus
Diffraction
Elastic vibrations in solids
Dispersion relations
Phonons
Specidic heat
The Debye model
Phonon phonon interaction
Electronic properties of solids

Free electron models, nearly free electron models, and strongly bound electron models
Band models
Electrical properties of solids
Different types of solid
Non-equilibrium phenomena
Transport equation
Application examples
Superconductivity
Magnetism
Tutorials
Periodic systems
Vibrations and phonons
Specific heat, paramagnetic susceptibility, the nearly-free electron
Electronic structure of graphene
Semiconductors and the P-N junction - applications
The field effect transistor and the 2-D electron gas
The quantum Hall effect

Requirements
M1 level in physics

Evaluation mechanism
written exam (2-3 hours)

Teaching coordinator : Dimitri Roditchev
Term : physics option
Number of hours : 18
ECTS Credits : 2
Last Modification : Wednesday 05 July 2017

PM Physics of measurement

Lectures: 13 h - Laboratory sessions: 11 h
ObjectivesThe goals of this lectures are as follows :
Provide technical bases of signal filtering
Evidence the many uses of Fourier Transform for linear systems
Introduce to non-linear problems and some of their characteristics.

Syllabus
Non-linear systems and introduction to chaos
Classical concepts on signal processing
Laws of probability and applications to noisy signals
Central limit theorem
Its direct application to an experimental signal does not work!
Correlation time of an experimental signal
Averaging and lock-in detection
1D Fourier transform
Signal decomposition on an orthogonal basis, example

orthogonal polynomials
Harmonics, Dirac signal, importance of phase
Fourier, an ideal basis for linear equations
Discrete transform and periodic signals. Principle of 2N FFT algorithm
Artefacts in FFT
Filtering, correlation, convolution, applications
Digitising and Shannon's theorem
Filtering before digital conversion, aliasing
Case of a camera, consequence of the lack of filtering in the time domain
2D Fourier transform
Convolution and deconvolution, sharpening a blurred photograph
Reconstructing an image in Fourier space
X-rays - Principle of tomography
New microscopy techniques with a greater optical resolution than that given by the Rayleigh criterion
Physics of noise
Different types of noise and their physical origins
Shot noise and measurement of the elementary charge
Noise of a resistor, analogy with Brownian motion. Fluctuation-dissipation theorem
Spectral characteristics of physical noise. Spectral density of noise. 1/f noise
Noise variation with temperature
Adaptation of an amplifier in a measurement system
Laboratory sessions
Three half-day sessions are devoted to:
Image and signal processing : rotation of images either simulated or recorded in tiff and jpeg formats.
Filtering applied to signals, simulated images (fractals from Julia and Mandelbrot) and real images.
Particle Image Velocimetry algorithm (PIV): this method enables to measure the velocity field of small particles advected by a fluid flow using video recording.
Tomography reconstruction: reconstructing a 2D image using a set of 1D projections performed at different angles around the same axis.

Evaluation mechanism

a 2h written examination, and a report + matlab program illustrating one of the themes of the laboratory sessions.

Teaching coordinator : Vincent Croquette, Isabelle Rivals
Term : physics option
Number of hours : 24
ECTS Credits : 3,5
Last Modification : Wednesday 08 March 2017

OMC Waves in complex media

Lectures: 12 h
ObjectivesUnderstand the phenomena of wave scattering in disordered media (eg soft matter, biological tissues). Introduce the imaging techniques based on measurements of average diffuse intensity (transport) or speckle (interferences). The main thread of the course is optical imaging, but emphasis is placed on the generality of concepts and methods and many references are made to acoustics and electronic transport.

Syllabus
Scattering of light by particles
Multiple scattering and transport in a scattering medium
Speckle
Dynamic light scattering
Links to other course modulesThe lecture is transversal by nature. Although the course is organized around optical propagation and imaging in scattering media (Optics course), the connection is established with acoustic propagation (Waves and acoustics course) and electronic transport (Solid state physics course). The statistical approach used to model transport and speckle links to the Statistical mechanics course. The lecture naturally opens up applications for the characterization of soft matter (dynamic light scattering) and biomedical imaging.

Requirements

Wave propagation and light-matter interaction (electromagnetic waves, optics and wave and acoustics courses).

Evaluation mechanism

Homework.

Teaching coordinator : Emmanuel Bossy
Term : physics option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Tuesday 05 September 2017

MIF Microfluidics

Lectures: 12 h - Preceptorship: 6 h
ObjectivesThe aim is to introduce students to the multidisciplinary realm of microfluidics. The course includes a general introduction to microsystems, MEMS, the "lab on a chip", DNA chips, etc. We will explain how the equilibria of "ordinary" systems are upset by miniaturisation. We will then concentrate on flow in microsystems, and the phenomena of adsorption, dispersion and separation in microfluidic systems. There will follow a description of electrokinetic phenomena, often exploited in microsystems for fluid transport or molecular separation. Finally, at an elementary level, we will present the current microfabrication techniques based on silicon or other materials which enable microsystems to be built.

Syllabus
General introduction to microsystems
The physics of miniaturisation
Flow in microsystems
Adsorption and mixing phenomena; applications to separation in microsystems
Electrokinetic phenomena: electro-osmosis, electrophoresis, dielectrophoresis
Introduction to microfabrication techniques
Preceptorship
Analysis of an article and demonstration of the corresponding experiment, for example:
Analysis of a chemical reaction in a microchannel
Breakup of droplets in a microchannel
Structure of microdroplets in a microchannel

Requirements
Basics of physics, hydrodynamics, biology, physico-chemistry.

Evaluation mechanism
Written exam based on an article study given before to the students.

Teaching coordinator : Patrick Tabeling
Term : core curriculum
Number of hours : 18
ECTS Credits : 2
Last Modification : Wednesday 31 May 2017

COB Colloidal Matter and Biomolecules

Lectures: 11 h
ObjectivesThis course deals with the dynamics and the microscopic behaviour of colloids and more particularly bioactive colloids, such as proteins, enzymes and antibodies. The three first parts are theoretical and provide methods to rationalize and model interacting systems with specificity and catalysis. The last part describes how the evolution of the colloidal science has been exploited to design new health diagnostic devices from the 20th century to the last discoveries and strategies currently developed by start-ups.

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What are the dynamics of dissociation of bio-complexesÂ and how can we study the properties of these associations?
How to apply colloidal science to medical diagnostic

Requirements
Diffusion, chemical kinetics.

Evaluation mechanism
Written examination.

Teaching coordinator : JÃ©rÃ´me Bibette
Term : physical chemistry option
Number of hours : 11
ECTS Credits : 1,5
Last Modification : Monday 10 July 2017

MA Advanced materials

Lectures: 24h - Visit of a Saint-Gobain plant: one day

ObjectivesThe objective of this conference series in English is to give an opportunity to the students to learn about research activities in academics or industry in the field of materials sciences.

SyllabusThis series of lectures is common with Ecole Polytechnique students within the activities of the Saint-Gobain/Ecole Polytechnique/ESPCI Chair. It consists in a series of 8 lectures (3 hours) given by professors in various fields of materials sciences. In addition a visit of a Saint-Gobain plant is scheduled for a one day trip.

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S. Granick (Korean center for basic research): For those who are bored with thermodynamics: physics of active colloids
Visit of Sully Saint-Gobain plant: production of glass for aeronautics industry

Evaluation mechanism
Summary of the conferences and personal literature review on a topic related to one of the conferences.

Term : physical chemistry option
Number of hours : 30
ECTS Credits : 4
Last Modification : Thursday 23 February 2017

IM Medical imaging: from measurements to images

Lectures: 18 h
ObjectivesTo understand image formation from measured signals.

SyllabusThe first part of the course deals with routine imaging techniques (MRI, ultrasound, CT). The second part introduces more recent techniques, some of which still being the topic of very active research fields (elastography, photoacoustic imaging, optical nanoscopy).

Requirements
Fourier Transform. Bases on acoustic and electromagnetic wave propagation.

Evaluation mechanism
Personal homework, either based on documents to read or problems to illustrate with matlab code. Choice left to each students (amonst 3 articles or 3 problems to code).

Teaching coordinator : Emmanuel Bossy
Term : physics option
Number of hours : 18

ECTS Credits : 3
Last Modification : Tuesday 30 May 2017

MSc in Engineering

ESPCI 3Ã¨me annÃ©e Option Physico-Chimie

Program Language: French

Content:

- Trois cours obligatoires :
Physique du solide (4 ECTS)
Chimie Inorganique AvancÃ©e (2 ECTS)
Apprentissage statistique ou ChimiomÃ©trie (1 ECTS)

- Des cours de spÃ©cialitÃ© Ã choisir parmi des cours de physique et de chimie pour un total de 11 Ã 13 ECTS (5 Ã 8 ECTS de physique/5 Ã 8 ECTS de chimie).

Enseignements de chimie :
RhÃ©ologie (1 ECTS)
Chimie Inorganique AvancÃ©e (2 ECTS)
SynthÃ¨se des polymÃ¨res (3 ECTS)
Biochimie (1,5 ECTS)
RÃ©activitÃ© (1,5 ECTS)
SynthÃ¨se Organique (3 ECTS)

Enseignements de physique :
Physique de la mesure (3 ECTS)
Ondes en milieux complexes (1,5 ECTS)
Biophysique (1,5 ECTS)

- Des cours d'option Ã choisir (pour un total compris entre 3 et 4,5 ECTS) parmi :
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Introduction au GÃ©nie NuclÃ©aire, (3 ECST)
TÃ©lÃ©coms AvancÃ©s (1.5 ECTS)
Physique des composants microÃ©lectronique (1.5 ECTS)
Environnement et dÃ©veloppement Durables, (1.5 ECTS)
Etats ColloÃ¯daux et Bio-colloÃ¯des, (1.5 ECTS)
Biotransformation et gÃ©nie des procÃ©dÃ©s (1.5 ECTS)
ou
GÃ©nie Chimique (option 2 mutualisÃ©e avec lâ€™ENSCP) (2 ECTS)

- un Â« enseignement dâ€™ouverture Â» au choix parmi les modules suivants qui sont ouverts Ã toutes les dominantes : (5 ECTS)
Chimie Fine et Biologie
SystÃ¨mes Ã©nergÃ©tiques

Informatique
MatÃ©riaux sur mesures (option mutualisÃ©e avec lâ€™X)
MÃ©thodes et Instrumentation pour imagerie mÃ©dicale
RelativitÃ© et ElectromagnÃ©tisme

Program Contents :

- Solid State Physics
- Advanced inorganic chemistry
- Chemometrics
- Advanced inorganic chemistry
- Polymer chemistry
- Molecular biotechnology
- Advanced selective organic synthesis
- Physics of measurement
- Waves in complex media
- Microfluidics
- Colloidal Matter and Biomolecules
- External courses: ENSCP_OPT_GC2 (Link to ParisTech)
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Last Modification: Tue 30 June 2009

PS3 Solid State Physics

Lectures: 18 h
ObjectivesWhen we seek to describe the electrical, magnetic, optical or thermal behaviour of solids, taking into account the large number of atoms per unit volume, it is not possible to carry out a precise analysis based on the behaviour of each atom.
Solid state physics makes it possible to construct models which, when experimentally verified, may be considered as representative.
The formalism constructed to this end has numerous applications. Examples in diverse fields and which sometimes appear to be far removed from solid state physics will be given.

Syllabus
Diffraction
Elastic vibrations in solids
Dispersion relations
Phonons
Specidic heat
The Debye model
Phonon phonon interaction
Electronic properties of solids

Free electron models, nearly free electron models, and strongly bound electron models
Band models
Electrical properties of solids
Different types of solid
Non-equilibrium phenomena
Transport equation
Application examples
Superconductivity
Magnetism
Tutorials
Periodic systems
Vibrations and phonons
Specific heat, paramagnetic susceptibility, the nearly-free electron
Electronic structure of graphene
Semiconductors and the P-N junction - applications
The field effect transistor and the 2-D electron gas
The quantum Hall effect

Requirements
M1 level in physics

Evaluation mechanism
written exam (2-3 hours)

Teaching coordinator : Dimitri Roditchev
Term : physics option
Number of hours : 18
ECTS Credits : 2
Last Modification : Wednesday 05 July 2017

CIA Advanced inorganic chemistry

Lectures: 12 h
ObjectivesMore than 80% of manufacturing processes include at least one catalysed reaction. Catalysis generally makes it possible to reduce costs (energy, separation, reprocessing, etc.) and limit the use of toxic and hazardous materials. The economic and environmental stakes are thus obvious.
In order to thoroughly understand the phenomena involved, the course presents the different types of catalysis through the study of major industrial processes and basic living cycles.
The problems related to the performance and optimisation of a catalytic system, its cost and environmental impact are highlighted and explained via a mechanistic kinetic approach.
The course is based on the knowledge acquired in the second year in Chemistry and Inorganic materials.

Syllabus
Industrial catalysis
Catalysis: fundamental concepts
Catalysis and major industrial processes
Heterogeneous catalysis mechanisms and kinetics
Heterogeneous catalytic system performances

Biocatalysis
Elements of the biosphere
Acidic catalysis, zinc enzyme
Redox catalysis
Industrial processes using biocatalysts

Requirements
Basics of Inorganic and organometallic chemistries, basics of homogeneous catalysis.

Evaluation mechanism
Two homeworks (biocatalysis + homogeneous and heterogenous catalyses) based upon a scientific paper.

Teaching coordinator : Corinne SouliÃ©, Sophie Norvez
Term : chemistry option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Friday 22 February 2019

CMT Chemometrics

Lectures: 12 h
ObjectivesThis course aims at the acquisition of the chemometric tools required for the rational design of experiments and allowing an optimal processing of the results. A special care is brought to the links between statistical conclusions, their physico-chemical interpretation and resulting practical conclusions.

Syllabus
Oneway ANOVA (Analysis of Variance)
Principle and purpose
Statistical tests
ANOVA table and interpretation
Case studies
Linear regression
Principle and purpose
Regression statistics
Confidence and prediction hyperbols
Model matching
Case studies
Designs of experiments
Principle and purpose
2n factorial designs
Significance of effects
2n-p fractional factorial and screening designs
Response surface designs

Requirements
Applied Statistics course.

Evaluation mechanism

Two hours and written examination (including the evaluation of Applied statistics).

Teaching coordinator : JÃ©rome Vial
Term : chemistry option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Wednesday 31 May 2017

CIA Advanced inorganic chemistry

Lectures: 12 h
ObjectivesMore than 80% of manufacturing processes include at least one catalysed reaction. Catalysis generally makes it possible to reduce costs (energy, separation, reprocessing, etc.) and limit the use of toxic and hazardous materials. The economic and environmental stakes are thus obvious.
In order to thoroughly understand the phenomena involved, the course presents the different types of catalysis through the study of major industrial processes and basic living cycles.
The problems related to the performance and optimisation of a catalytic system, its cost and environmental impact are highlighted and explained via a mechanistic kinetic approach.
The course is based on the knowledge acquired in the second year in Chemistry and Inorganic materials.

Syllabus
Industrial catalysis
Catalysis: fundamental concepts
Catalysis and major industrial processes
Heterogeneous catalysis mechanisms and kinetics
Heterogeneous catalytic system performances
Biocatalysis
Elements of the biosphere
Acidic catalysis, zinc enzyme
Redox catalysis
Industrial processes using biocatalysts

Requirements
Basics of Inorganic and organometallic chemistries, basics of homogeneous catalysis.

Evaluation mechanism
Two homeworks (biocatalysis + homogeneous and heterogenous catalyses) based upon a scientific paper.

Teaching coordinator : Corinne SouliÃ©, Sophie Norvez
Term : chemistry option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Friday 22 February 2019

CP Polymer chemistry

Lectures: 12 h - Tutorials: 4 h
ObjectivesThis course aims at providing the concepts and tools used in macromolecular engineering to design and prepare polymers at will.
To this aim, the general characteristics of the two main polymerization families are presented, i.e. chain growth and step growth polymerizations, and the most significant examples of each family are discussed in great details, namely radical polymerization and polycondensation, respectively.
The concepts presented during lectures and tutorials (synthetic methodology, structure/reactivity relationship, reaction mechanisms, kinetics, polymerization processes) should allow for the rational design and synthesis of polymers while taking into accounts structural parameters such as molar masses, dispersity, composition, topology and functionality.

Syllabus
Introduction
Thermoplastics / Thermosets
Chain-growth polymerization / Step-growth polymerization
Few properties of polymers
Macromolecular engineering
Radical polymerization
Structure/reactivity relationship
Elementary steps
Initiation
Propagation
Termination
Transfer and telomerization
Degree of polymerization
Copolymerization
Controlled radical polymerization
Concepts and characteristics
Nitroxide-mediated radical polymerization (NMP)
Atom transfer radical polymerization (ATRP)
Reversible addition-fragmentation chain-transfer polymerization (RAFT)
Radical polymerization processes
Bulk polymerization
Solution polymerization
Suspension polymerization
Emulsion polymerization
Step-growth polymerization
Degree of polymerization
Molar masses and molecular weight distribution
Gel point and networks
Kinetics of step-growth polymerizations
Main families of polymers obtained by polycondensation and polyaddition
Macromolecular engineering
Molar masses and molecular weight distribution
Composition: copolymers
Topology: grafted polymers
Topology: branched polymers
Topology: dendrimers
Functionality: chemical modification
Tutorials

Radical and controlled radical polymerizations
Polycondensation and polyaddition

Requirements
Basic concepts in organic chemistry.

Evaluation mechanism
Written examination.

Teaching coordinator : Renaud NicolaÃ¿
Term : core curriculum
Number of hours : 16
ECTS Credits : 2
Last Modification : Monday 05 June 2017

BTM Molecular biotechnology

Lectures: 12 h - Tutorials: 5 h
ObjectivesUnderstanding of state-of-the art methods in biotechnology and their application for fundamental and applied research.

SyllabusThe lectures will cover state-of-the-art recombinant DNA techniques, including:
amplification
cloning
synthesis
sequencing (including next-generation sequencing)
mutagenesis (directed and random)
recombination
targeted genome editing (e.g. using CRISPR/Cas9)
overexpression of recombinant proteins
screening and selection
directed evolution
These techniques will be exemplified by presenting a number of important applications of molecular biotechnology:
protein engineering for fundamental studies and industrial applications of enzymes
protein engineering for therapeutic applications (e.g. therapeutic antibodies)
engineering of diagnostic systems
engineering of vaccines
TutorialsAssistance with group projects to prepare a short educational course (Powerpoint) to be presented to the rest of the class (15 min presentation + 5 min for questions).

Requirements
Basic knowledge of biochemistry/molecular biology.

Evaluation mechanism
Two hour written exam (70% of marks) + group project (30% of marks).

Teaching coordinator : Andrew Griffiths

Term : biotechnologies option
Number of hours : 17
ECTS Credits : 2
Last Modification : Monday 12 June 2017

ASOS Advanced selective organic synthesis

Lectures : 20 h - Tutorials: 4 h
ObjectivesFine organic chemistry is everywhere, in medicinal products, perfumes, cosmetics, materials, etc. Knowing the bases of organic synthesis is essential for a chemist.This course is intended for chemists and aims to introduce them to the new reactions used in organic synthesis, for example. This work is applied in the study of major syntheses of biologically active products. These studies additionally constitute a first relative approach to Organic Chemistry synthesis strategies.

Syllabus
Chemoselective alkylation reactions
Organocatalytic reactions
Organometallic coupling reactions
Metathesis and applications
Organometallic coupling reactions with palladium, iron and copper
Catalytic oxydation and reduction reactions
Functional group interconversions
Radical reactions
Rearrangement reactions
Aromatic and non-aromatic heterocycle syntheses

Requirements
To have mastered the first year CHO module

Evaluation mechanism
Written exam with course questions and problems

Teaching coordinator : Amandine GuÃ©rinot, Christophe Meyer, VÃ©ronique Bellosta, Domingo Gomez-pardo
Term : biotechnologies option
Number of hours : 24
ECTS Credits : 4
Last Modification : Saturday 08 December 2018

PM Physics of measurement

Lectures: 13 h - Laboratory sessions: 11 h
ObjectivesThe goals of this lectures are as follows :
Provide technical bases of signal filtering
Evidence the many uses of Fourier Transform for linear systems
Introduce to non-linear problems and some of their characteristics.

Syllabus
Non-linear systems and introduction to chaos
Classical concepts on signal processing
Laws of probability and applications to noisy signals
Central limit theorem
Its direct application to an experimental signal does not work!
Correlation time of an experimental signal
Averaging and lock-in detection
1D Fourier transform
Signal decomposition on an orthogonal basis, example
orthogonal polynomials
Harmonics, Dirac signal, importance of phase
Fourier, an ideal basis for linear equations
Discrete transform and periodic signals. Principle of 2N FFT algorithm
Artefacts in FFT
Filtering, correlation, convolution, applications
Digitising and Shannon's theorem
Filtering before digital conversion, aliasing
Case of a camera, consequence of the lack of filtering in the time domain
2D Fourier transform
Convolution and deconvolution, sharpening a blurred photograph
Reconstructing an image in Fourier space
X-rays - Principle of tomography
New microscopy techniques with a greater optical resolution than that given by the Rayleigh criterion
Physics of noise
Different types of noise and their physical origins
Shot noise and measurement of the elementary charge
Noise of a resistor, analogy with Brownian motion. Fluctuation-dissipation theorem
Spectral characteristics of physical noise. Spectral density of noise. 1/f noise
Noise variation with temperature
Adaptation of an amplifier in a measurement system
Laboratory sessions
Three half-day sessions are devoted to:
Image and signal processing : rotation of images either simulated or recorded in tiff and jpeg formats.
Filtering applied to signals, simulated images (fractals from Julia and Mandelbrot) and real images.
Particle Image Velocimetry algorithm (PIV): this method enables to measure the velocity field of small particles advected by a fluid flow using video recording.
Tomography reconstruction: reconstructing a 2D image using a set of 1D projections performed at different angles around the same axis.

Evaluation mechanism

a 2h written examination, and a report + matlab program illustrating one of the themes of the laboratory sessions.

Teaching coordinator : Vincent Croquette, Isabelle Rivals
Term : physics option
Number of hours : 24
ECTS Credits : 3,5
Last Modification : Wednesday 08 March 2017

OMC Waves in complex media

Lectures: 12 h
ObjectivesUnderstand the phenomena of wave scattering in disordered media (eg soft matter, biological tissues). Introduce the imaging techniques based on measurements of average diffuse intensity (transport) or speckle (interferences). The main thread of the course is optical imaging, but emphasis is placed on the generality of concepts and methods and many references are made to acoustics and electronic transport.

Syllabus
Scattering of light by particles
Multiple scattering and transport in a scattering medium
Speckle
Dynamic light scattering
Links to other course modulesThe lecture is transversal by nature. Although the course is organized around optical propagation and imaging in scattering media (Optics course), the connection is established with acoustic propagation (Waves and acoustics course) and electronic transport (Solid state physics course). The statistical approach used to model transport and speckle links to the Statistical mechanics course. The lecture naturally opens up applications for the characterization of soft matter (dynamic light scattering) and biomedical imaging.

Requirements

Wave propagation and light-matter interaction (electromagnetic waves, optics and wave and acoustics courses).

Evaluation mechanism

Homework.

Teaching coordinator : Emmanuel Bossy
Term : physics option
Number of hours : 12
ECTS Credits : 1,5
Last Modification : Tuesday 05 September 2017

MIF Microfluidics

Lectures: 12 h - Preceptorship: 6 h
ObjectivesThe aim is to introduce students to the multidisciplinary realm of microfluidics. The course includes a general introduction to microsystems, MEMS, the "lab on a chip", DNA chips, etc. We will explain how the equilibria of "ordinary" systems are upset by miniaturisation. We will then concentrate on flow in microsystems, and the phenomena of adsorption, dispersion and separation in microfluidic systems. There will follow a description of electrokinetic phenomena, often exploited in microsystems for fluid transport or molecular separation. Finally, at an elementary level, we will present the current microfabrication techniques based on silicon or other materials which enable microsystems to be built.

Syllabus

General introduction to microsystems
The physics of miniaturisation
Flow in microsystems
Adsorption and mixing phenomena; applications to separation in microsystems
Electrokinetic phenomena: electro-osmosis, electrophoresis, dielectrophoresis
Introduction to microfabrication techniques
Preceptorship
Analysis of an article and demonstration of the corresponding experiment, for example:
Analysis of a chemical reaction in a microchannel
Breakup of droplets in a microchannel
Structure of microdroplets in a microchannel

Requirements

Basics of physics, hydrodynamics, biology, physico-chemistry.

Evaluation mechanism

Written exam based on an article study given before to the students.

Teaching coordinator : Patrick Tabeling
Term : core curriculum
Number of hours : 18
ECTS Credits : 2
Last Modification : Wednesday 31 May 2017

COB Colloidal Matter and Biomolecules

Lectures: 11 h
ObjectivesThis course deals with the dynamics and the microscopic behaviour of colloids and more particularly bioactive colloids, such as proteins, enzymes and antibodies. The three first parts are theoretical and provide methods to rationalize and model interacting systems with specificity and catalysis. The last part describes how the evolution of the colloidal science has been exploited to design new health diagnostic devices from the 20th century to the last discoveries and strategies currently developed by start-ups.

SyllabusKey question that are adressed in this course are:
How do colloids diffuse in their environment via Brownian motion?
How do biomolecules and colloids react and associateÂ in a complex medium? How can we model the interactions between a ligand and a receptor on cell membranes?
What are the dynamics of dissociation of bio-complexesÂ and how can we study the properties of these associations?
How to apply colloidal science to medical diagnostic

Requirements

Diffusion, chemical kinetics.

Evaluation mechanism

Written examination.

Teaching coordinator : JÃ©rÃ´me Bibette
Term : physical chemistry option
Number of hours : 11
ECTS Credits : 1,5
Last Modification : Monday 10 July 2017

MA Advanced materials

Lectures: 24h - Visit of a Saint-Gobain plant: one day
ObjectivesThe objective of this conference series in English is to give an opportunity to the students to learn about research activities in academics or industry in the field of materials sciences.

SyllabusThis series of lectures is common with Ecole Polytechnique students within the activities of the Saint-Gobain/Ecole Polytechnique/ESPCI Chair. It consists in a series of 8 lectures (3 hours) given by professors in various fields of materials sciences. In addition a visit of a Saint-Gobain plant is scheduled for a one day trip.

The program changes every year, below is the 2017 program:E. WimmerÂ (Materials design): ab initio numerical simulations to predict materials properties
U. Steiner (EPFL): photonic materials obtained by self assembly
P. Van Mechelen (ABB corp): Hydrogen transport in materials
J.-M. TarasconÂ (CollÃ¨ge de France): 20 years of development of materials for batteries
P. Ohashi (NIMS, Japan): Challenges in materials sciences for energy and sustainable development
K. Scrivener (EPFL): Cementitious materials, green chemistry in action
A. Saint-Jalmes (Institut Physique de Rennes): physics and chemistry challenges involved in the stabilization of aqueous foams
S. Granick (Korean center for basic research): For those who are bored with thermodynamics: physics of active colloids
Visit of Sully Saint-Gobain plant: production of glass for aeronautics industry

Evaluation mechanism
Summary of the conferences and personal literature review on a topic related to one of the conferences.

Term : physical chemistry option
Number of hours : 30
ECTS Credits : 4
Last Modification : Thursday 23 February 2017

IM Medical imaging: from measurements to images

Lectures: 18 h
ObjectivesTo understand image formation from measured signals.

SyllabusThe first part of the course deals with routine imaging techniques (MRI, ultrasound, CT). The second part introduces more recent techniques, some of which still being the topic of very active research fields (elastography, photoacoustic imaging, optical nanoscopy).

Requirements

Fourier Transform. Bases on acoustic and electromagnetic wave propagation.

Evaluation mechanism

Personal homework, either based on documents to read or problems to illustrate with matlab code. Choice left to each students (amonst 3 articles or 3 problems to code).

Teaching coordinator : Emmanuel Bossy
Term : physics option
Number of hours : 18
ECTS Credits : 3
Last Modification : Tuesday 30 May 2017

ESPCI 4Ã¨me annÃ©e

Program Language: French

Aims:

AprÃ¨s le cycle socio-Ã©conomique de dÃ©but dâ€™annÃ©e, les Ã©lÃ¨ves rejoignent les cursus universitaires classiques en France (Master Recherche 2) ou Ã lâ€™Ã©tranger (Masters of Science), avec poursuite Ã©ventuelle en thÃ¨se de doctorat ou PhD, ou encore, complÃ¨tent leur formation dans diverses Ã©coles dâ€™application ou instituts spÃ©cialisÃ©s (doubles diplÃ´mes ou MastÃ¨res SpÃ©cialisÃ©s). Il existe un grand nombre de possibilitÃ©s qui sont toutes Ã©tudiÃ©es au cas par cas par la Direction des Etudes, en fonction du projet professionnel de chaque Ã©tudiant.

Last Modification: Wed 16 November 2005