PCM - Physics and Chemistry of Matter - S6

PHYSIQUE

PHYSICS

Lecturers: **Emmanuel DROUARD, Anne-Segolene CALLARD, Magali PHANER**

| Lecturers : 16.0 | TC : 22.0 | PW : 0.0 | Autonomy : 3.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

The aim of this course is to provide the basic knowledges of quantum physics necessary to describe both the matter at microscopic scale and the main processes of radiation - matter interaction (emission, diffusion, absorption). These processes will be addressed both from classical and quantum point of view, and studied in particular in the frame of applications such as light sources and detectors, and lasers.

Keywords : Quantum mechanics, atomic and nuclear physics, photon - matter interactions, wave propagation in media

Programme

- Wave propagation, dispersion.
- Classical description of electromagnetic waves/material media interactions: optical properties of dielectrics and metals.
- Limits of classical physics.
- Wave - particle duality. Schrödinger equation and applications.
- Atomic and molecular physics. Physics of the nucleus.
- Semiclassical/quantum description of the photon matter interaction.
- Light sources and detectors.
- Principles of laser. Properties and applications of lasers.

Learning outcomes

- To be able to apply the Schrödinger equation to simple systems.
- To know how to rely macroscopic properties of matter to their microscopic origins.
- To know how to describe the different radiation - matter interactions.
- To be able to give the orders of magnitude of the energies implied in these interactions.

Independent study

Objectifs : Understanding and assimilating the course.

Méhodes : Now how to remake and interpret tutorials.
On line exercises & multiple choice training.
Microtest and Questions/Answers session with teachers.

Core texts

B. Cagnac, *ATOMES ET RAYONNEMENT, INTERACTIONS ÉLECTROMAGNÉTIQUES*, Dunod, 2005
B. Cagnac *L'ATOME, UN ÉDIFICE QUANTIQUE.*, Dunod, 2005
B.E. Saleh, M.C. Teich*FUNDAMENTAL OF PHOTONICS*, Wiley, 2007

Assessment

Mark=100% knowledge. Mark of knowledge = 85 % final exam + 15%.

CHIMIE

CHEMISTRY

Lecturers: **Virginie MONNIER-VILLAUME, Naoufel HADDOUR**

| Lecturers : 8.0 | TC : 12.0 | PW : 0.0 | Autonomy : 5.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This lecture aims to provide bases in chemistry and physico-chemistry of materials necessary to understand properties of materials at the microscopic scale (kinetics, reactivity, thermodynamics, weak bonds, electrochemistry). Applications such as new materials to produce energy (organic solar cells), power plants or vehicles working with renewable fuels, will be used to illustrate quantum chemistry and molecular interactions notions.

Keywords : Chemistry, materials, molecular orbitals, statistical thermodynamics, weak bonds, kinetics, electron transfer

Programme

- Quantum model of the chemical bond.
- Introduction to statistical thermodynamics.
- Chemical reactivity and elements of chemical kinetics.
- Electron transfer at interfaces.
- Weak bonds.

Learning outcomes

- Build and use a diagram of molecular orbitals for a molecular structure.
- Make the link between physico-chemical properties at the macroscopic and at the microscopic scale of the matter.
- Identify molecular interactions and binding energies involved in a molecule.
- Select adapted theoretical knowledge to be applied to concrete new problems in chemistry.

Independent study

Objectifs : Learn and digest basic notions before each lecture, to use them between lectures and tutorials. Understand the links between the different notions of the lecture. Remobilize lecture concepts in concrete new situations.

Méhodes : Reading of the duplicated lecture notes and self-evaluation with the corrected exercises on Moodle platform.

Core texts

Michel GUYMONT, *STRUCTURE DE LA MATIÈRE. ATOMES, LIAISONS CHIMIQUES ET CRISTALLOGRAPHIE*, Belin, 2003
P. W. ATKINS, J. DE PAULA *CHIMIE PHYSIQUE*, De Boeck, 2013
J. P. PEREZ, A. M. ROMULUS*THERMODYNAMIQUE. FONDEMENTS ET APPLICATIONS.*, Masson, 2001

Assessment

Final mark = 100% Knowledge.
Knowledge = 70% final exam + 30% continuous assessment.

TRAVAUX PRATIQUES CHIMIE-PHYSIQUE, PHOTONIQUE

LAB SESSIONS PCM

Lecturers: Christelle YEROMONAHOS, Anne LAMIRAND

| Lecturers : 0.0 | TC : 0.0 | PW : 24.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

These practicals allow through lab experiments a better understanding of fundamental concepts taught in physics and chemistry lectures and tutorials, giving concrete applications of these concepts. Finally, important notions for an engineer, such as measurements validity and protocol set-up, are provided.

Keywords : Nanotechnology, Imaging, Laser, Spectroscopy, Chromatography, Chemical kinetics, Electrochemistry, Intermolecular bonds

Programme

- Students will follow 3 practical works (TP) in physics: Fourier optics. Infrared thermography / solar cell. Spectrophotometry.
- The students will follow 3 practical works (TP) in chemistry: Electrochemical study of galvanic corrosion of metals. Study of redox reactions by UV-Visible spectrophotometry - Chemical kinetics. Gas chromatography.

Learning outcomes

- C2N1: Defines a system and its boundaries, identifies the phenomena involved and proposes a simple model. Formulate the hypotheses.
- C2N3: Characterizes the complexity of a system, identifies interactions and sources of uncertainty.
- C3N3 : Communicates in a synthetic way in writing and orally to report and enhance the results.
- C5N3 :

Independent study

Objectifs : Prepare for practical work.

Méhodes : Reading documents on intranet.
Questionnaire to be completed and included in the report (chemistry) / Oral evaluation of the preparation at the start of the session (physics).

Core texts

Assessment

Score = 20% knowledge + 80% know-how. Knowledge score = preliminary test. Know-how score = report + handling and participation.