UNIVERSITÉ PARIS SUD | FACULTÉ DES SCIENCES D'ORSAY

UNIVERSITE PARIS-SUD

Faculté des Sciences d'Orsay

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Undergraduate physics courses in English

for 2017/2018

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UNIVERSITÉ PARIS SUD | FACULTÉ DES SCIENCES D'ORSAY

General organization of the undergraduate Physics studies at Paris Sud University (Orsay Faculty)

The Physics department at Paris Sud University is located on the Orsay campus, south of Paris. This document summarizes the physics studies that can be performed in English in Orsay at the undergraduate level.

The French University system follows the LMD (Licence – Master – Doctorate) scheme, after the *baccalauréat*, the end of high-school diploma, usually obtained at 18:
- 1st, 2nd and 3rd year of University: "Licence" or undergraduate studies (L1, L2 and L3)
- 4th and 5th year of University: "Master" or Graduate Studies (M1 and M2)
- 6th, 7th and 8th year: Doctorate

In the French system, classical physics is mainly taught during the first two years of University. Modern physics is only introduced in the 3rd year and 4th years. The 5th year is devoted to specialized master courses. A foreign student looking for a Master course on modern physics may find it in Orsay in the undergraduate program. Note also that the English program at Orsay starts on the 3rd year of University.

The admission to this program is competitive and requires the approval of the head of the program (see contact below).

The academic year is split into two semesters. The first one goes from September of December (exams beginning of January), the second one from January through June. Thirty credits (ECTS) are taught each semester.

Teaching in French Universities is done several ways:
- Lectures are given in front of all students in an auditorium or in a classroom, depending on the number of students.
- Small classes are done by groups with less than 28 students, and allow students to apply the concepts seen during lectures.
- Experimental work is performed by pair. There are at most 6 pairs per group.

All lectures described in this report are given both in French and in English. One of the small classes is given in English. The small classes always immediately follows the corresponding lecture, allowing students to have all hours concerning one topic in the same half day.

French students have the ability to follow one or more English lecture(s). This ensures the foreign students are mixed with French ones. Experimental work is done in English for foreign students upon request.

To get the French degree, students have to pass compulsory and optional courses to receive 30 credits per semester. Foreign students have the ability to follow all or part of this program, depending on the request from their home University. They are also able to follow one or more lecture(s) in French if their University requests it.

Please note that special French classes are available for foreigners.

During their studies French students have to perform internships in Orsay laboratories. This is also available for foreign students. The number of credits granted for these internships will depend on the exchange program.

For more information about the program, please contact the head of the program:

Pr Patrick Puzo
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http://www.magistere.u-psud.fr

First semester (September to December)

French students have to get 30 credits on this semester. Foreign students can pick the course(s) they want, depending on their University request. Note that most of the final exams are planned for the first week of January 2018.

Compulsory courses:

	Lectures	Small Classes	Laboratories	Credits
Mathematical tools for physics		25 h		2,5
Analytical mechanics	27 h	27 h		5
Quantum mechanics I	24 h	24 h		5
Statistical physics I	12 h	12 h		2
Mathematics	36 h	36 h		7
Programming	14 h	26 h		3
English		33 h		3

PhysF300 - Mathematical tools for physics (Pr C. Pasquier)
Small classes 25 hours (2,5 ECTS)
The goal of this course is to give an overview of the most popular mathematical tools needed for physics. This is especially necessary for foreign students who will follow French teaching. A MOOC will be available in September 2017 to adjust the student's level to our requirements.

PhysF303 - Analytical mechanics (Pr J.M. Rax & Dr C. Falvo)
Lecture 27 hours - Small classes 27 hours (5 ECTS)
The goal of this course is to provide a first introduction to Hamiltonian and Lagrangian dynamics.

PhysF301a - Quantum mechanics I (Dr M. Langer)
Lecture 24 hours – Small classes 24 hours (5 ECTS)
The goal of this course is to provide a first introduction to quantum physics, covering the following topics:
- Quantum phenomena
- Principles, Postulates and Measurements in Quantum Mechanics
- General formulation of Quantum Mechanics
- Symmetries
- Angular momentum
- Spin-orbital angular momentum and Magnetic Resonance

PhysF313a - Statistical physics I (Pr P. Simon)
Lecture 12 hours - Small classes 12 hours - (2 ECTS)
The goal of this course is to provide a first introduction to statistical physics, covering the following topics:
- Probabilities
- Fundamental postulate of statistical physics

- Microcanonic ensemble
- Entropy, temperature
- Irreversibility

PhysF302 – Mathematics (Dr R. Zegers)
Lecture 36 hours – Small classes 36 hours (7 ECTS)
This course introduces some of the most popular mathematical tools needed in physics, including:

- Holomorph functions
- Measure theory and Lebesgue integrals
- Fourier transforms
- Distributions and Green functions
- Hilbert spaces in finite dimensions

PhysF304a – Programming (Dr B. Van Tent)
Lecture 14 hours - Small classes 26 hours (3 ECTS)
The aim of this module is to learn C to be able to simulate physics phenomena, using numerical simulations or not. During this module, we shall see in particular:

- Introduction to shell commands
- Extensive use of freeware for plotting, image treatment, visual animations, sound analysis
- Monte-Carlo computations, numerical resolution of differential equations

Lang301F – English (Dr D. Thom)
Small classes 33 hours (3 ECTS)
This class focuses on developing oral fluency and confidence (Pecha Kucha / short interactive group presentations). A wide range of creative / current topics ('Arts, Science and Society') are covered to maximize student participation. Assessment also includes argumentative essay-writing.

Optional courses (in French):

They are usually performed by groups of less than 25 students.

PhysF351 - Data analysis and numerical methods for physics (Dr S. Roccia)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF353 - Mathematical Physics (Pr R. Parentani)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF371 - Outreach in Physics (Pr J. Bobroff)
Laboratories 25 hours (2,5 ECTS)

PhysF365a - Organic chemistry I (Dr C. Bour)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF366 - Group theory (Dr H. Bergeron)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

Hist303 - History of electricity and electromagnetism (Dr V. Fonteneau)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

Second semester (January to June)

French students have to get 30 credits on this semester. Foreign students can pick the course(s) they want, depending on their University request.

Compulsory courses:

	Lectures	Small Classes	Laboratories	Credits
Classical Electrodynamics	30 h	30 h		6
Quantum mechanics II	12 h	12 h		3
Statistical physics II	24 h	24 h		6
Special Relativity	14 h	14 h		2
Programming Project		12 h		3
Experimental Project	8,5 h		59,5 h	6
Experimental Work			14 h	1,5

PhysF312 – Classical electrodynamics (Pr E. Khan & Dr B. Van Tent)
Lecture 30 hours () - Small classes 30 hours - (6 ECTS)
This course starts from Maxwell equations and discuss:

- Properties of electromagnetic field: energy, momentum and angular momentum of electromagnetic field
- Dielectric and magnetic media, seen from microscopic and macroscopic views
- Induction theory and link to special relativity
- Free propagation in vacuum and in dielectric media, wave guides
- Radiant systems

PhysF301b - Quantum mechanics II (Dr M. Langer)
Lecture 12 hours - Small classes 12 hours (3 ECTS)
The goal of this course is to strengthen the already acquired basis in Quantum Mechanics I during the first semester, and to introduce some special topics and methods. The course will cover:

- The Hydrogen atom (first approach)
- Addition of Angular Momenta
- Systems of Identical Particles; Symmetry Postulates
- Fine structure and Hyperfine splitting of the Hydrogen atom
- Approximation Methods in Quantum Mechanics: Time-independent perturbation theory
- Evolution of real systems: the time-dependent Hamiltonian and time-dependent perturbation theory

PhysF313b - Statistical physics II (Pr P. Simon & Pr G. Foffi)
Lecture 12 hours - Small classes 12 hours - (2 ECTS)
The goal of this course is to strengthen the already acquired basis in Statistical Physics I, covering the following topics:

- Semi classical description of gas
- Themodynamics of harmonic oscillators
- Quantum statistics
- Grand canonical ensemble

- Bose-Eisntein condensation

PhysF307 - Special relativity (Pr L. Verstraete & Pr B. Espagnon)
Lecture 14 hours - Small classes 14 hours - (2 ECTS)

The aim of this lecture is to provide a first overview of special relativity, leading to the Maxwell equation. We shall see in particular:

- Postulate of special relativity and their consequences
- Space-time structure
- Lorentz transform
- Covariant formalism
- Electromagnetic tensor and Maxwell equation

PhysF304b - Programming project (Dr B. Van Tent)
Small classes 12 hours - (3 ECTS)
Personal project aiming to solve a physical problem via computing

PhysF314 - Experimental project (Dr F. Bouquet)
Lecture 8,5 hours - Laboratories 59,5 hours (6 ECTS)

This experimental module aims to realize a complete experiment in statistical physics, from the data acquisition to the final result analysis. It starts with the learning of Labview™ and provides an experience of data acquisition via an acquisition board. After this, the students have to setup the experiment and the Labview™ program needed for the problem they have to solve. Possible topics are magnetization of gadolinium, black body radiation, superconductivity, thermo-emission, etc… These experiments are seen as an initiation to experimental physics performed in research laboratories.

PhysF305 - Experimental work (Dr F. Bouquet)
Laboratories 14 hours (1,5 ECTS)

This experimental module is twofold. The first part deals with the discovery of X ray physics via an introduction to several diffraction methods and their applications to the study of the material structures. The second part concerns wave propagation in a metallic guide.

Optional courses (in English):

They are usually performed by groups of less than 25 students.

PhysF381 - Introduction to dynamical system and pattern formation (Dr M. Langer)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

Ways of Seeing, Ways of Knowing (Dr C. Quay)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF383 - Physics of biological systems (Pr N. Hildebrandt)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

Optional courses (in French):

They are usually performed by groups of less than 25 students, apart from the first two ones.

Introduction to phase transition and collective phenomena (Pr G. Foffi)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)
Note that the lecture will be given in French, but the manuscript will be written in English.

Application of Quantum Mechanics (Pr P. Simon)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF355 - Experimental Techniques for teaching (Dr L. Simard)
Laboratories 25 hours (2,5 ECTS)

PhysF361 - Introduction to Astrophysics (Dr M. Langer)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF365b - Organic chemistry II: Dr C. Bour
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF363 - Cosmology, general relativity, and recent observations (Pr R. Parentani)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysF369 - Introduction to medical physics (Dr E. Porcel)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

Chim395 - Molecular Gastronomy (Pr R. Haumont)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

PhysM333 - Introduction to geophysics (Dr A. Tudryn)
Lecture 12 hours – Small classes 13 hours (2,5 ECTS)

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