Semester 5

ISP-INF-S05-01		**Mathematics S05**	**12 ECTS**
SPM-MAT-001	3	Mathematics for engineers	36.0 h
SPM-PHY-001	2	Quantum Physics 1	21.0 h
SPM-MAT-002	3	Probability	24.0 h
SPM-SIC-001	3	Signals and systems	36.0 h
SPM-NCL-001	1	Introduction to research	12.0 h

ISP-INF-S05-02		**Computer Science S05**	**10 ECTS**
SPM-INF-005	3	Computer architecture	36.0 h
SPM-INF-001	1	Free software for engineers	13.5 h
SPM-INF-003	4	Introduction to C/C++ programming	42.0 h
SPM-INF-002	2	Python for scientists	21.0 h

ISP-INF-S05-21		**HEP S05**	**4 ECTS**
SPM-HEP-008	1	Project Management	15.0 h
SPM-HEP-001	1	Oral and written communication	15.0 h
SPM-HEP-003	1	Engineer, environment and society	12.0 h
SPM-HEP-002	1	Scientific dissemination project	12.0 h
SportS05	P/F	Sport S05	21.0 h

ISP-INF-S05-15		**Foreign Language S05**	**4 ECTS**
LV1S05	1	Foreign language and culture 1	21.0 h
LV2S05	1	Foreign language and culture 2	21.0 h

Semester 6

ISP-INF-S06-04		**Computer Engineering S06**	**12 ECTS**
SPM-INF-007	3	C++ programming	42.5 h
SPM-INF-010	3	Operating systems	32.0 h
SPM-INF-008	2.5	Computer Networking	26.5 h
SPM-INF-006	2	Relational databases	18.0 h
SPM-PRJ-002	1.5	C++ programming project	18.0 h

ISP-INF-S06-03		**Engineering Sciences S06**	**9 ECTS**
SPM-MAT-003	2	Statistics	25.5 h
SPM-AUT-001	3	Systems and Models	36.0 h
SPM-INF-009	4	Data structures and algorithms	44.5 h
SPM-NCL-002	P/F	Introduction to research	12.0 h

ISP-INF-S06-22		**HEP S06**	**5 ECTS**
SPM-HEP-005	1	Economic, Industrial and Financial Systems	18.0 h
SPM-HEP-009	1	Scientific dissemination project	14.0 h
SPM-HEP-006	1	Commons	12.0 h
SPM-HEP-023	1	Job Application Preparation	15.0 h
SportS06	P/F	Sport S06	21.0 h
SPM-STA-001	P/F	Execution internship	0.0 h

ISP-INF-S06-16		**Foreign Language S06**	**4 ECTS**
LV1S06	1	Foreign language and culture 1	21.0 h
LV2S06	1	Foreign language and culture 2	21.0 h

Evaluation methods: 3h written test, can be retaken.

Quantum Physics 1

Course supervisor: Damien Rontani, Nicolas Marsal

Total: 21.0 h   **CM:** 12.0 h, **TD:** 7.5 h

Bibliography:

- Ref. [1] : C. Cohen-Tannoudji, F. Laloë, B.Diu, Mecanique Quantique – Tome 1, EDP Science CNRS Edition (2018)

- Ref. [2] : J.-L. Basdevant, J. Dalibard, Mécanique Quantique, Ellipse Edition (2006)

Evaluation methods: 1h30 written test, can be retaken.

Probability

Course supervisor: Michel Barret

Total: 24.0 h

Evaluation methods: 1h30 written test, can be retaken.

Course supervisor: Stéphane Rossignol

Total: 36.0 h   **CM:** 18.0 h, **TD:** 6.0 h, **TP:** 12.0 h

Bibliography:

- Ref. [1] : Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall

Evaluation methods: Practical reports

Course supervisor: Nicolas Marsal

Total: 12.0 h

CM: 6.0 h, **TD:** 4.5 h, **TP:** 1.5 h

Evaluated skills:

- Business Intelligence

Computer architecture

Course supervisor: Jérémy Fix

Total: 36.0 h   **CM:** 10.5 h, **TD:** 3.5 h, **TP:** 20.0 h

Description: This course deals with computer architecture, starting with the transitor and gradually building up the various layers of abstraction to finally reach programming. We'll see the building blocks of information routing (multiplexer), memory (flip-flops, registers) and information processing (arithmetic and logic units) enabling the creation of data paths and their sequencing. The course ends with the programming of the architecture built in a language close to assembler and the realization of a mini-game, and ends by opening perspectives towards operating systems. All practical exercises will be carried out in Logisim simulation.

Learning outcomes: At the end of this course, students will have an understanding of how a computer works, based on logic gates and flip-flops. In particular, they will be prepared to make the link between what they write in C/C++ and execution on the machine.

Evaluation methods: 2h written test, can be retaken.

External resources:

- Site du cours

Free software for engineers

Course supervisor: Jérémy Fix

Total: 13.5 h   **CM:** 1.5 h, **TP:** 12.0 h

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Description: This course introduces the main tools of the free software world useful to an engineer. It covers the use of bash to interact with the system, the philosophy behind GNU tools and how to combine them (pipelines, IO redirection, etc.). We'll also take a look at how to combine various tools (git, python, awk, sed, lynx, ffmpeg, make), using them to carry out two projects. Assessment will be based on the practical reports.

Learning outcomes: At the end of this course, students will be able to interact with a Linux computer, invoking and articulating free software tools via a bash-like command interpreter.

Evaluated skills:

- Development

External resources:

- Site du cours

Introduction to C/C++ programming

Course supervisor: Hervé Frezza-Buet

Total: 42.0 h   **CM:** 10.5 h, **TD:** 4.5 h, **TP:** 24.0 h

Description: This course covers C programming, focusing on execution threading (loops, function calls, recursive functions), memory manipulation (structured types, pointers, stack and heap, binary representations). The first steps towards object-oriented design (encapsulation without the syntax of an object language like C++). This course also covers the aspecst of separate compilation (headers, external variables, linkage, dynamic libraries, etc.).

Learning outcomes: On completion of this course, students will be able to write, compile and debug C/C++ programs involving the basic elements of the language.

Evaluation methods: 3-hour individual computer test, can be retaken.

Evaluated skills:

- Development

External resources:

- C++ web pages

Python for scientists

Course supervisor: Jérémy Fix

Total: 21.0 h

CM: 3.0 h, **TP:** 18.0 h

Description: The aim of this teaching unit is to train students in the tools of the Python ecosystem for scientists. It covers the use of specialized libraries for a number of major themes: scientific computing with Numpy, signal processing with Scipy, managing and processing large volumes of data with pandas, formatting results with matplotlib and an introduction to machine learning with scikit-learn.

Learning outcomes: At the end of this course, students will be able to mobilize the tools of the Python ecosystem for the experimental parts of their scientific activities.

Evaluation methods: Practical reports

Evaluated skills:

- Development

External resources:

- Site du cours

Project Management

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Total: 15.0 h   **CM:** 12.0 h

Description: This course is designed to make students more effective in managing their projects by providing methodological frameworks and practical tools. They will learn to plan, organize, monitor, and lead a project and a team in various contexts. This course is complemented by the "Management" course, which focuses more specifically on the human aspects of managing individuals and groups.

Learning outcomes: By the end of this course, students will have mastered the fundamentals of project management tools and methods, enabling them to effectively lead all phases of a collaborative project.

Evaluation methods: Case study

Evaluated skills:

- Management

ORAL AND WRITTEN COMMUNICATION

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Total: 15.0 h

CM: 4.0 h, **TP:** 11.0 h

Description: This course provides essential tools for effective oral and written communication in academic and professional contexts. On the oral side, students will learn how to speak in public, lead meetings and conduct interviews, manage their speaking time, and adapt to videoconferencing situations. On the written side, they will practice drafting various types of documents (technical or scientific reports, meeting minutes, specifications, responses to calls for projects, etc.), focusing on clear structure and content, while using appropriate tools for formatting and presentation.

Learning outcomes: By the end of this course, students will be able to communicate clearly, effectively, and professionally in a variety of situations, both in writing and orally.

Evaluated skills:

- Management

Engineer, environment and society

Course supervisor: Julien Colin

Total: 12.0 h

CM: 6.0 h, **TD:** 2.0 h, **TP:** 4.0 h

Description: This course aims at providing students with fundamental knowledge of the life cycles of resources (energy and non-energy: production/extraction, consumption, end-of-life) and their impact on climate and biodiversity, in relation to the demographic and geopolitical challenges of the 21st century.

Learning outcomes: At the end of this course, students will be familiar with the global challenges facing humanity and its environment in the 21st century, and will have an overview of their levers as citizens and engineers.

Evaluation methods: evaluation of involvement (mandatory and controlled attendance) and of a step back note.

Scientific dissemination project

Course supervisor: Hervé Frezza-Buet, Virginie Galtier

Total: 12.0 h **Projet:** 12.0 h

Evaluation methods: Report describing the planned classroom intervention

Evaluated skills:

- Management

Sport S05

Course supervisor: Hervé Frezza-Buet

Total: 21.0 h **TD:** 21.0 h

Foreign language and culture 1

Course supervisor: Elisabeth Leuba

Total: 21.0 h <div align="right">**TD:** 21.0 h</div>

Description: The first foreign language is generally English. Students are divided into level groups ; in class, work is not only focused on the 4 language competences but also on various topics studied in depth according to students' levels. Topics cover a range of fields, such as civilisation, society and the professional world. Limited class size enables active participation and significant improvement in the language. The educational approach is varied: group work, class presentations, specific exercises, research, debates, etc.

Learning outcomes: At the end of the course, students will have improved their ability to communicate in an international professional, academic or personal context.

Evaluated skills:

- Research and Development
- Consulting
- Business Intelligence
- Management

Foreign language and culture 2

Course supervisor: Beate Mansanti

Total: 21.0 h **TD:** 21.0 h

Description: Students are offered a range of second foreign languages at different levels, including for beginners. Students are divided into level groups; in class, work is not only focused on the 4 language competences but also on various topics studied in depth according to students' levels. Topics cover a range of fields, such as civilisation, society and the professional world. Limited class size enables active participation and significant improvement in the language. The educational approach is varied: group work, class presentations, specific exercises, research, debates, etc.

Learning outcomes: At the end of the course, students will have improved their ability to communicate in an international professional, academic or personal context.

Evaluated skills:

- Research and Development
- Consulting
- Business Intelligence
- Management

C++ programming

Course supervisor: Hervé Frezza-Buet, Frédéric Pennerath

Total: 42.5 h

SPM-INF-007

Evaluation methods: 3-hour individual computer test, can be retaken.

Evaluated skills:

- Development

- Modelling

- Certification

Operating systems

Course supervisor: Michel Ianotto

Total: 32.0 h

SPM-INF-010

Evaluation methods: MCQ and evaluation of participation in practical work

Evaluated skills:

- System

- Development

Course supervisor: Virginie Galtier

Total: 26.5 h   **CM:** 12.0 h, **TD:** 3.0 h, **TP:** 10.5 h

Evaluation methods: 1h written test, can be retaken.

Evaluated skills:

- System

- Development

Relational databases

Course supervisor: Virginie Galtier

Total: 18.0 h

CM: 3.0 h, **TD:** 1.5 h, **TP:** 12.0 h

Evaluation methods: 1h30 written test, can be retaken.

Evaluated skills:

- Modelling
- System
- Development

C++ programming project

Course supervisor: Hervé Frezza-Buet

Total: 18.0 h **Projet:** 18.0 h

Evaluation methods: Evaluation based on the code produced and uploaded to the git. Evaluation will also be based on ongoing monitoring by the supervisors.

Evaluated skills:

- Modelling
- Development
- Management

Course supervisor: Michel Barret, Joël Legrand

Total: 25.5 h

CM: 12.0 h, **TD:** 9.0 h, **TP:** 3.0 h

Evaluation methods: 1h30 written test, can be retaken.

Systems and Models

Course supervisor: Damien Rontani, Jean-Luc Collette

Total: 36.0 h

SPM-AUT-001

Evaluation methods: Labworks evaluation.

Evaluated skills:

- Modelling

Data structures and algorithms

Course supervisor: Nicolas Jozefowiez

Total: 44.5 h **CM:** 19.5 h, **TD:** 6.0 h, **TP:** 16.0 h

Evaluation methods: 3h written test, can be retaken.

Evaluated skills:

- Development

- Modelling

Introduction to research

Course supervisor: Nicolas Marsal

Total: 12.0 h

CM: 10.5 h, **TP:** 1.5 h

Evaluated skills:

- Business Intelligence

Economic, Industrial and Financial Systems

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Total: 18.0 h **CM:** 15.0 h

Description: This course offers a critical examination of contemporary economic, industrial, and financial systems through their origins, dynamics, and impacts. Building on a theoretical foundation, it explores the tensions between economic imperatives and environmental limits. Discussions with field practitioners (elected officials, business leaders) will enrich the reflection by confronting theoretical concepts with industrial and territorial realities.

Learning outcomes: By the end of this course, students will understand the foundations and mechanisms of current economic, industrial, and financial systems. They will be able to analyze their interactions and will gain tools to explore alternative models that align with contemporary social and ecological challenges.

Evaluated skills:

- Business Intelligence

Scientific dissemination project

Course supervisor: Hervé Frezza-Buet, Virginie Galtier

Total: 14.0 h   **Projet:** 12.0 h

Evaluation methods: Evaluation intervention in classroom and deliverables

Evaluated skills:

- Management

COMMONS

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Total: 12.0 h **CM:** 12.0 h

Description: This course offers an introduction to the commons, exploring their conceptual, legal, and economic foundations, as well as their role in the emergence of more open, sustainable, and collaborative production models. The course is structured around three main themes: first, the principles of the commons, their historical development, legal frameworks, and the limits of their implementation; second, the economic models that allow open source and low-tech projects to grow while staying true to their core values; and finally, the challenges related to open data, illustrated through geographic data, with a focus on privacy protection tools, regulatory frameworks, and emerging issues linked to artificial intelligence.

Learning outcomes: At the end of this course, students will be aware of the existence of commons and the free economy; they will understand their potential, challenges, and the tools for implementation, management, and governance.

Evaluation methods: Students will be asked to imagine a project involving open data and to present the potential value it could create, identify the resources to be secured, and anticipate potential challenges.

JOB APPLICATION PREPARATION

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Total: 15.0 h   **CM:** 15.0 h

Description: The aim of this course is to develop students' career management skills. It will first help them identify their first job opportunity, go through the recruitment process successfully, and transition into the professional world. Later, these skills will support them when they wish to change positions or switch sectors. Finally, the course will provide insights for the day they find themselves in a recruiting role.

Learning outcomes: By the end of this course, students will be prepared for all stages of the recruitment process — before, during, and after job application.

Evaluation methods: The evaluation will be based on observations of the students' involvement.

Course supervisor: Hervé Frezza-Buet

Total: 21.0 h

32

TD: 21.0 h

Course supervisor: Hervé Frezza-Buet, Damien Rontani

Evaluation methods: PASS/FAIL evaluation based on the submission of an internship report.

Foreign language and culture 1

Course supervisor: Elisabeth Leuba

Total: 21.0 h   **TD:** 21.0 h

Description: The first foreign language is generally English. Students are divided into level groups ; in class, work is not only focused on the 4 language competences but also on various topics studied in depth according to students' levels. Topics cover a range of fields, such as civilisation, society and the professional world. Limited class size enables active participation and significant improvement in the language. The educational approach is varied: group work, class presentations, specific exercises, research, debates, etc.

Learning outcomes: At the end of the course, students will have improved their ability to communicate in an international professional, academic or personal context.

Evaluated skills:

- Research and Development

- Consulting

- Business Intelligence

- Management

Foreign language and culture 2

Course supervisor: Beate Mansanti

Total: 21.0 h **TD:** 21.0 h

Description: Students are offered a range of second foreign languages at different levels, including for beginners. Students are divided into level groups; in class, work is not only focused on the 4 language competences but also on various topics studied in depth according to students' levels. Topics cover a range of fields, such as civilisation, society and the professional world. Limited class size enables active participation and significant improvement in the language. The educational approach is varied: group work, class presentations, specific exercises, research, debates, etc.

Learning outcomes: At the end of the course, students will have improved their ability to communicate in an international professional, academic or personal context.

Evaluated skills:

- Research and Development
- Consulting
- Business Intelligence
- Management