CENTRALESUPELEC

FIRST YEAR COURSES CATALOG

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CORE CURRICULUM COURSES

1CC1000 – Information Systems and Programming

Instructors: Guillaume MAINBOURG
Department: TECHNIQUE DE L'INFORMATION - SYSTÈMES AVANCÉS
Language of instruction: FRANCAIS, ANGLAIS
Campus: Rennes, CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

Three successive courses help train students in programming and algorithmic. This course is the first one, followed by two weeks of programming (Coding Weeks) and the Algorithmic & Complexity course.
The 1st year students have very different levels in these fields, because of their previous course (prep classes including "MP Option Info", other universities, ...) and their personal taste for programming (some have already participated in programming contests).
This course is not asking for any advanced notion in algorithmic. However, all students must validate a minimum common level, and the most advanced students will be able to go further.
The programs that students will be able to write at the end of the three courses will be useful to the other courses of CS, to the labs, but also, on a first level, for associations of the campus and companies.

Quarter number

SG1

Prerequisites (in terms of CS courses)

None in terms of CS courses. As the first Common core course, prerequisites are:
- SQL, as seen in Preparatory classes in "Informatique pour tous"
- Notions of Python or 1st experience of another programming

Syllabus

The course is made of 24 slots of 1h30mn, with 5 lectures ("amphis"), 17 tutorials ("TD") and 2 exams. The lecture part is relatively small, as the chosen approach is "Learning by doing".
The chapters of the course are a follows:
Python
- Introduction : usages (scientific, Web sites, etc.)
- Interpreter, command line, scripts
- Variables, objects types, basic display

- Tests, loops, lists, sets, functions, modules, dictionaries, files, databases
- Display capabilities
- Finding and using external libraries (numpy, matplotlib)
- Manipulating text

Debugging, test plan, « clean code »

Data modeling and relational databases
- Relational databases, Logical data model
- Physical data model
- SQL queries

Performance (computer, network basics), security

Class components (lecture, labs, etc.)

Tutorials ("TD") are with exercises on paper and on computer.
Each student must load on his personal computer, before the course, a programming environment (coordinated with CS Computer Department).
Reinforced support is in place at the beginning of the course to ensure that all students have access to the necessary environment.
TD classrooms are equipped with a wired Internet access for each student (RJ45 connection), giving the ability to look for resources on Internet.
During the tutorials ("TD"), each student produces his/her own code, even if discussions are favored.
The overall structure of a TD is:
- Quick presentation of the TD theme
- A first exercise, easy to solve, with possible access to a Python reference manual
- Gradual rise of the proposed exercises difficulty
- After the first two introductory TDs, at each TD, a "clean code" step: take the code of an exercise and improve it by applying the rules of "good programming"
- In the same way, a "test plan" step: build a test plan for an exercise.

Grading

Two exams of 1h30mn are organized, on paper, with no access to a computer, and without any document.
In the middle of the course, the first exam is covering Information Systems and Programming. For instance:
- Programming exercises on paper, with access to a reference manual for more complex syntax that is not to be memorized
- A logical data model to create, and to transform into a physical data model
- SQL queries exercises.

The text of this exam is in English, although answers can be given in FR or in EN.
The second exam is at the end of the course. It is based on Multiple Choice Questions, on paper, in English, with automatic grading by scanning the exam sheets. The grade of each student is known before Coding weeks can start.
Bonus points can be given, based on "TD" contribution (0 to +2 pts).
Final grade = 50% 1st exam + 50% final exam + bonus points.

Course support, bibliography

The course support is :
- A course book for Information Systems
- A reference manual for Python and "clean code"

Resources

• Teaching staff (instructor(s) names): Guillaume Mainbourg, Céline Hudelot
• Maximum enrollment (default 35 students): 35 students for each Tutorial class ("TD")
• Required hardware: a personal computer with minimal configuration (currently being defined with CS Computer Department)
• Software, number of licenses required: Open-source software, or free for students
• Equipment-specific classrooms (specify the department and room capacity): no

Learning outcomes covered on the course

For a given problem, write a program in a high level programming language using base control structures and advanced structures (collections, dictionaries), SQL, recursivity, static or dynamic typing, with input/output, and with exception handling.
- Know and apply good programming practices, good code structure (clear and sensible), modularity and use of existing libraries or modules, programming interfaces, allow readability of a program (naming conventions, simplicity, comments, …).
- Know the basics for software quality, test by simple methods (such as black box), unit tests.
- Know the tools for software development: know how to configure and use an integrated development environment.
- Know the concepts around the execution environment of a program: base of the command line interface, file, executable, interpreted / compiled code.
This competence is validated by a « Milestone 1" ("Jalon 1") and will be reinforced with the Development Project ("CS Coding Weeks").

1CC2000 – Algorithmics and Complexity

Instructors: Nicolas SABOURET
Department: TECHNIQUE DE L'INFORMATION - SYSTÈMES AVANCÉS
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY, Rennes
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The goal of this course is to introduce computer science methods for engineering problem solving. It presents different problem families using theoretical models. It shows how to solve these problems using sequential or parallel algorithms. We question the existence of a solution and we take great care to the quality of the computed solution. We study the complexity of the problems as well as the complexity of the resolution algorithms.

Quarter number

ST2

Prerequisites (in terms of CS courses)

SG1 – Informations systems and programming (ISP)

Syllabus

Lecture #1: Introduction – decision and optimization problems, solution, algorithm, algorithm complexity, graph representation, non-weighted graph search
Lecture #2: Directed Acyclic Graph (DAG) traversal and scheduling, parallel search, weighted graph search (Dijkstra)
Lecture #3: Minimum spanning tree, Prim and Kruskal algorithms, distributed algorithms
Lecture #4: Maximum flow, Ford-Fulkerson, applications
Lecture #5: Hashing – general principle, algorithms and applications
Lecture #6: Introduction to dynamic programming
Lecture #7: Ford-Bellman, application to distributed routing algorithms
Lecture #8: Complexity of problems, polynomial reduction, NP-completeness
Lecture #9: Exact methods for solving NP-hard problems : backtrack, Branch & Bound – Traveling Salesman Problem (TSP)
Lecture #10: Approximation : meta-heuristics, greedy algorithm, 2-approximation for TSP

Class components (lecture, labs, etc.)
10x1h30 lectures
12x1h30 Tutorials, including 4 lab studies
2x1h30 exam

Grading

- Written examination: 60 % - all documents allowed
- Lab studies (2x3h + homework) : 20 %
- Interrogations during tutorials (MCQ) : 20 %

Course support, bibliography
A booklet will be given to the students starting sept. 2019.
All slides will be available online.

Students can refer to the following textbooks:

- *Introduction to Algorithms*, Third Edition. By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. MIT Press, 2009.
- *Algorithm Design*. By Jon Kleinberg et Éva Tardos. Pearson Ed. (Addison-Wesley), 2006.
- *Programmation Efficace : Les 128 Algorithmes Qu'Il Faut Avoir Compris et Codés en Python au Cours de sa Vie.* Par Christophe Dürr et Jill-Jênn Vie. Ellipse, 2016. (in French)

Resources

- Teaching staff (instructor(s) names):
  - Céline HUDELOT
  - Wassila OUERDANE
  - Fabrice POPINEAU
  - Arpad RIMMEL
  - Nicolas SABOURET
  - Safouan TAHA
  - Joanna TOMASIK
  - Marc-Antoine WEISSER
- Maximum enrolment (default 35 students): 25 students max per tutorial group
- Software, number of licenses required: Python Integrated Development Environment (PyCharm, Spyder, etc)
- Equipment-specific classrooms (specify the department and room capacity)

Learning outcomes covered on the course

After this course, students will be capable of :

- Computational thinking, or reasoning with an algorithmic view to solve real-life problems problems;
- Knowing the general methods to write an algorithm (brute force, divide and conquer, etc) and applying these methods to solve a problem;
- Using exact methods (dynamic programming, branch and bound, etc.) as well as heuristics (greedy, A*, etc.) to obtain approximate solutions to an optimization problem;
- Algorithm analysis to estimate the complexity in time and space;
- Studying the class of complexity of a problem so as to select the most relevant problem-solving methods.

1CC3000 – Model representations and analysis

Instructors: Guillaume Sandou, Cristina-Nicoleta Maniu, Véronique LE CHEVALIER
Department: MATHÉMATIQUES, AUTOMATIQUE
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

Current technological and scientific progress would not have arisen without the deep understanding and evolution of complex systems gathering different application fields such as energy, telecommunications, transport, aerospace, economy, healthcare, etc. System modeling plays a crucial role to drive it and to analyse interactions between its components or with other systems.

The students will be expected to be able to represent the behavior of a system with a model that can be exploited either analytically or digitally, well-suited to the model goal in link with some modeling assumptions both in terms of representativeness and complexity, and to evaluate its domain of validity.

To that aim, they will have to choose the relevant spatial and temporal scales and to select the most appropriate representation (discrete or continuous). Based on experimental data, they will be expected to be able to define the model structure, to identify its parameters despite inherent measurement noises, and to assess the validity of the model.

Quarter number

ST2

Prerequisites (in terms of CS courses)

Analysis, Probabilities, Basics of Computer Sciences

Syllabus

Hours given in this description correspond to on-site hours [33H + 3H for the final exam].
1) General introduction: from a system to a formal mathematical expression [Lecture 1H30]
• Model taxonomy (discrete / continuous / hybrid, deterministic / stochastic, mechanistic /data-driven, ...)
• Well-posedness

• Multi-scale, multi-model approaches
• Modeling approach and methodology
2) Modeling of continuous-state systems [Lectures 6H00; Tutorials: 4h30]
• Time representation of dynamical systems:
o Continuous time systems: state-space representation of a differential equation (linear or nonlinear), linearization around an equilibrium point or a trajectory, linear state-space model and its explicit solution, stability analysis by mean of an eigenvalue study.
o Discrete time systems: state-space representation of a difference equation (linear or nonlinear), focus on continuous processes driven by a digital input, linearization around an equilibrium point or a trajectory, linear state-space model and its explicit solution, stability analysis by mean of an eigenvalue study.
• Frequency representation:
o Transfer function of a continuous time linear and time invariant system: basic concepts on Fourier and Laplace transforms, frequency response (Bode diagram), time response (impulse response, step response, focus on 1st and 2nd order systems), link with the state-space representation
o Transfer functions of a discrete time linear and time invariant system: basic concepts on z transform, discretization (choice of the sampling period, choice of the discretization method), link with state-space representation
3) Modeling of discrete-state systems [Lectures: 3H00; Tutorials: 4h30]
• Automata, hierarchical automata, synchronous product of automata
• Multi-agent models, emergent behaviors
• Formal grammars
• Petri nets, concurrent processes modeling
• Discrete-event simulations, modeling of delays and event distributions (Rayleigh and Poisson distributions)
• Examples of hybrid models: modal models (automata and ordinary differential equation for instance)
4) Methods for the sensitivity analysis, the parameter identification and the evaluation of models [Lectures: 4H30; Tutorials: 4H30]
• Sensitivity analysis, perturbations, uncertainty analysis
• Model assessment: identifiability, basics of parameter identification (least square method, based on frequency response, based on time response), digital optimization, AIC (Akaike Information Criterion) / MSPE (Mean Squared Error of Prediction)
• Applications of the parameter estimation method for a simple model / a linear regression.
5) Illustration and application of the modeling approach [Lecture: 1H30; Tutorials: 3H00]
• Epistemology of models and simulations (Franck Varenne, lecture: 1h30).
• Tutorial on the modeling approach on real-life problems (development of a model for a physical problem, derived in several versions depending on the field (mass or heat transfer, AC/DC machines and converters, biotechnology, electromagnetism...)
6) Written final exam [2H30]; cross-evaluation of projects [0H30]
7) In parallel, students will have to carry out a project as part of their workload (and not during contact hours) consisting in:

• Phase 1: Definition of a subject (1 page for the description of the context and objectives and an appendix made of 5-6 pages giving relevant information on the system to model);
• Phase 2: development of a model for one of the proposed subject (randomly assigned to student groups). Deliverables: a simulator, a 2-3 page report, including a representative experiment to be tested to illustrate the relevance of the simulator with respect to the model description (equations, diagram, local rules…) and the physical intuition on the modeled system.

Class components (lecture, labs, etc.)

see syllabus

Grading

- Written final exam (2H30): 75% of the module mark, individual
- Project: 25% of the module mark, by groups of 4 students, divided into:
  - 40% for the evaluation of the proposed project (evaluated by the group assigned to that project)
  - 60% for the model development (evaluated by the group which defined the project)
- Penalty -2 points (on the project mark) if the evaluation of the project is not validated by the teacher team (based on a sampling x% among all groups)

Course support, bibliography

- Walter, É., & Pronzato, L. (1994). Identification de modèles paramétriques à partir de données expérimentales. Masson.
- Lamnabhi-Lagarrigue, F, Annaswamy, A, Engell, S, Isaksson, A, Khargonekar, P, Murray, RM Nijmeijer, H, Samad, T, Tilbury, D & Van den Hof, P 2017, 'Systems & Control for the future of humanity, research agenda: Current and future roles, impact and grand challenges' Annual Reviews in Control, vol 43, pp. 1-64.
- Saltelli, A. et al. (2008). Global sensitivity analysis: the primer. John Wiley & Sons.

Resources

- Teaching staff (instructor(s) names):
  Véronique Letort Le Chevalier (2x200 in French), Cristina Maniu (2x100 in French), Guillaume Sandou (2x100 in English)
- Maximum enrollment : 2x12 groups of 35 students
  List to be confirmed:

1. Véronique LETORT (2 groups)
2. Cristina MANIU (2 groups)
3. Guillaume SANDOU (2 groups, in English)
4. Gilles DUC (2 groups)
5. Cristina VLAD
6. Pedro RODRIGUEZ (in English)
7. Giorgio VALMORBIDA (in English)
8. Andreas MARKOULIDAKIS (in English)
9. Houria SIGUERDIDJANE (2 groups)
10. Stéphane FONT (2 groups)
11. Chengfang REN
12. Israel HINOSTROZA
13. Jacques ANTOINE
14. Antonin DELLA NOCE (2 groups)
15. Koen DE TURCK (in English)
16. Richard COMBES (2 groups)

- Software, number of licenses required : To be confirmed: Python, Matlab, R
- Equipment-specific classrooms (specify the department and room capacity): Tutorials in classical rooms, with student laptops.

Learning outcomes covered on the course

At the end of this course, students will be able to :

1. Choose the right model typology, that is well-suited to the model objective (simulation, optimization, control…): discrete/continuous, deterministic/stochastic, mechanistic (based on physical laws) /data driven (based on measured data), frequency/time based.
2. Model and analyze a continuous process, by using time and / or frequency representations; use basic parameter identification techniques based on a time or frequency response (least squares method for instance); anticipate the effect of sampling, and make use of discrete-time representations.
3. Model and analyze a discrete process in a relevant framework including automata, multiagent models, Petri nets, and discrete-events simulation.
4. Take a critical approach and analyze the reliability of the developed models: uncertainty propagation, sensitivity analysis (local and global methods based in particular on variance), selection of a model with regards to certain specifications.
5. Digitally implement the obtained model, simulate and validate, particularly in comparison with experimental data.

1CC4000 – Signal Processing

Instructors: Dominique Beauvois, Hana Baili
Department: SIGNAL ET STATISTIQUES, AUTOMATIQUE, TÉLÉCOMMUNICATIONS
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 40
On-site hours (HPE): 24
Quota :

Description

This course is an introduction to the basic notions and results of representing information bearing continuous or discrete-time signals. Signal Processing is also concerned with using algorithms to extract that information or to transform the signals in useful ways such as classification, compression, storage, transmission, restoration or detection.

Quarter number

ST4

Prerequisites (in terms of CS courses)

Core Curriculum course 1CC3000 “Modelling” (ST2)
Semester-Long Course 1SL1000 “Convergence, integration, probabilities, partial differential equations” (CIP-EDP)

Syllabus

First part: deterministic signals Deterministic signal modelling; energetic aspects: energy, power, correlation; spectral characterization: FT; filtering; stability; sampling; the Shannon theorem; anti-aliasing filtering; reconstruction. Deterministic signal analysis: spectral properties; spectral effect of truncation in the time domain; windowing and comparison; discrete Fourier transform and properties; spectral analysis. Second part: random signals Models for random signals: Markov processes; Brownian motion; Gaussian processes; Poisson process. Temporal representation of random signals: autocorrelation function, cross-correlation function; properties of second-order moments; different types of stationarity; white noise; sampling. Spectral analysis and filtering of random signals: power spectral density and properties; interference formulae; ARMA processes; spectral factorization; parametric and non-parametric spectral estimation. Ergodicity and estimation in the time domain: different levels of ergodicity; autocorrelation function estimation; properties of the estimators.

Class components (lecture, labs, etc.)
Lectures 7h30 -- Practical Session 3h -- Lectures 6h -- Practical Session 3h -- Practical Session 3h
Practical sessions include exercises, case studies, training on computer programs, etc.

Grading
Multiple-choice quiz (30 min)
Final written examination (1h30)
The final exam evaluation may cover all the learning outcomes; the examination may include:
- course's questions (outcomes 1 to 6),
- MCQs (outcomes 1 to 6),
- small exercises (outcomes 1 to 6),
- problems (outcomes 2, 3, 5, 6).
The assessment of learning outcomes at the beginning of the practical session on computer will be based on a multiple-choice quiz and will cover all the outcomes 1 to 6.

Course support, bibliography
Handout.

Resources
• Teaching staff (instructor(s) names): H. Baili, G. Chardon, J. Fiorina, E. Lahalle, J. Picheral, P. Rodriguez, G. Valmorbida, A. Wautier
• Maximum pratical session enrollment : 25
• Software, number of licenses required: Matlab, Unlimited Licence
• Equipment-specific classrooms (specify the department and room capacity): none

Learning outcomes covered on the course

At the end of this course, the student will be able:

1) To establish a model for various continuous or discrete time signals and systems using temporal or spectral concepts.

2) To design analog-to-digital or digital-to-analog signal conversion.

3) To characterize a signal via spectral analysis.

4) To model random signals using stochastic processes.

5) To estimate temporal and spectral characteristics of random signals.

6) To perform signal processing for estimation, detection and prediction.

1CC5000 – Statistics and Statistical Learning

Instructors: Paul-Henry COURNEDE
Department: MATHÉMATIQUES
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The objective of this course is to introduce the mathematical, methodological and computational bases of statistical inference from data. First, the principles and formalisms of mathematical statistics will be taught. This includes the definition of statistical models, the bases of estimation theory, the concepts of hypothesis testing. Second, the basic methods and algorithms of statistical learning will be introduced, including supervised learning for regression and classification as well as unsupervised learning. Finally, in relation with the specialized themed sequences, the students will be familiarized with a library of computational statistics.

Quarter number

ST4

Prerequisites (in terms of CS courses)

Analysis and Probability

Syllabus

1. Random variables and samples, descriptive statistics, empirical measure.

2. Statistical models and problems of statistical inference

    a. Families of distributions and parametric models
    b. Exhaustive statistics, factorization theorem, exponential family.
    c. Regression Models

3. Parameter estimation.

    a. A few estimators: method of moments, maximum likelihood
    b. Properties of estimators (bias, consistency, risk, Cramer-Rao bound, asymptotic properties, asymptotic normality, consistency and asymptotic normality of the ML estimator)
    c. Central limit theorem, Delta method, Continuity theorem,

Slutsky's theorem
d. Confidence regions

4. Bayesian Estimation: Bayes theorem, prior and posterior distributions, conjugate distributions, loss function and Bayesian point estimates.

5. Hypothesis Testing

a. General framework and method for testing statistical hypotheses: alternative hypotheses, risks and power, test statistics, rejection region, p-value
b. Parametric tests: Neyman-Pearson lemma, asymptotic tests.
c. Non-parametric tests (adequacy tests: chi2, Kolmogorov-Smirnov, Cramer Von-Mises; population comparison tests: Wilcoxon)

6. Linear regression, generalized additive models, trees. Model selection. L1-penalty (lasso) and L2-penalty (ridge regression), cross-validation.

7. Logistic model for classification.

8. An introduction to neural networks.

9. Principal Component Analysis. Unsupervised learning for clustering (K-means, hierarchical clustering)

Class components (lecture, labs, etc.)
9 x 1H30 lectures + 9 x 1H30 exercise classes + 2 x 3H practical classes + 2 x 1H30 Exams

This course offers a student-adapted pace : Yes.
Same course duration, but 2 types of practical classes: "standard" with 100 students per class, "moderate" with 33 students per class.

Grading
1 intermediate exam + 1 final exam + Practical classes.

Course support, bibliography

- Lecture notes + exercise book
- Casella, G., & Berger, R. L. (2002). Statistical inference (Vol. 2). Pacific Grove, CA: Duxbury.
- Friedman, J., Hastie, T., & Tibshirani, R. (2001). The elements of statistical learning (Vol. 1, pp. 241-249). New York: Springer series in statistics.

Resources

- Teaching staff (instructor(s) names): Paul-Henry Cournède, Laurent Le Brusquet, Julien Bect
- Maximum enrollment :
  - Exercise Classes :
    - 6 EC with 100 in French
    - 3 EC with 30-35 in French (Moderate level)
    - 3 ECs with 30-35 in English (Moderate level)
  - Practical Classes : 24PC with 33 students (3 per themed sequence)
- Software, number of licenses required: depending on the themed sequence
- Equipment-specific classrooms (specify the department and room capacity): Normal classrooms with practical work on students laptops.

SEMESTER LONG COURSES

1SL1000 – CIP-EDP

Instructors: Erick HERBIN, Pauline LAFITTE
Department: MATHÉMATIQUES
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 120
On-site hours (HPE): 72
Quota :

Description

The objective is to have students master the mathematical concepts and formalisms of the modelling of complex systems, through
• the analysis of integro-differential models ; the techniques of approximation and their convergence
• the construction of transforms to solve problems
• the deep knowledge of measure theory, as the basis of the modern framework of probability, necessary to describe fluctuating phenomena, and of the data processing
This theoretical framework will allow to tackle the techniques of signal processing and the statistical study of data in common core courses. In second year, students will be able to confort these bases by studying stochastic processes and nonlinear phenomena in advanced courses.

Quarter number

Semester long
SG1, ST2, SG3

Prerequisites (in terms of CS courses)

None

Syllabus

- Quarter 1 :

Topology
Metric spaces
Normed vector spaces
Hilbert spaces
Continuous dynamical systems
Cauchy problems
Finite differences in time

Measured spaces
Construction of the integral with respect to a measure
Interverting limits and integrals
Probability, random variables
Distributions and Sobolev spaces in 1D

- Quarter 2 :

Product measures Probability on R^N, independence
Distributions and Sobolev spaces in d D
Resolution of elliptic problems by variational formulation
Variational approximation and 1D finite elements
2D finite elements
Finite differences in space
Numerical matrix analysis
Discretizing parabolic problems
Convolution
Fourier transform and characteristic functions
Gaussian vectors

- Quarter 3 :

Solving parabolic problems
Convergence of sequences of random variables
Conditional expectation
Random walks

Class components (lecture, labs, etc.)
Workload (HEE): 120 HEE at normal pace, 60 HEE at fast pace (90 HEE if combined with the advanced courses of "Parcours Recherche), 180 HEE at reinforced pace
Contact hours1 (HPE): 72 HEE at normal pace, 36 HEE at fast pace (54 HEE if combined with the advanced courses of "Parcours Recherche), 108 HEE at reinforced pace

- fast pace : lectures (exercises at home + advanced lectures of "Parcours Recherche")
- normal pace : lectures and labs (deductive learning)
- reinforced pace: preparatory courses (inductive learning) + lectures + labs

Labs : semi-flipped classrooms (preparatory exercises at home)

Grading
30mn MCQs, 2 partial exams of 1h30 and 2 final exams of 3h.
Documents and electronic devices are not allowed during the evaluations

Course support, bibliography

No handout, but an extensive bibliography (books, electronic documents, exercise book)

Resources

• Teaching staff (instructor(s) names): Erick Herbin / Pauline Lafitte in French and John Cagnol / Alexandre Richard in English
• Maximum enrollment (default 35 students): 100
• Software, number of licenses required: Matlab (800)
• Equipment-specific classrooms (specify the department and room capacity): 0

1SL2000 – General management

Instructors: Éléonore MOUNOUD
Department: SCIENCES ENTREPRISE
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 40
On-site hours (HPE): 24
Quota :

Description

This course aims to offer engineering students a structured presentation of the main issues of business management and development. The aim is to ensure that outgoing engineering students have a clear vision of what companies are, their objectives, their organization, their partners, and the challenges and alternatives offer to guide their development. The course aims to propose an integrated vision of the principles of management of a company.

Quarter number

ST2

Prerequisites (in terms of CS courses)

None

Syllabus

1. Introduction: actors, issues, stocks and flows, operating and renewal cycles
2. Marketing of products and services: studies, decisions, operations
3. Growth methods and strategic maneuvers: supply chain, global value chain
4. Corporate Strategy: Vision, Mission, Competitive environment, Generic strategies
5. Performance management: introduction to management (objectives, budgets, indicators)
6. Innovation: from new products marketing to intensive innovation strategies

Class components (lecture, labs, etc.)

The course will take place in two parallel sessions organized in ST2 for the first 6 sessions of the course. The last two sections of the course will take place during the week and will be devoted to the evaluation of the course as part of the Start Up Week. Each session consists of 6 lectures of 1h30, 5 sessions of TP of 1h30, a conference of a and 2 sessions of evaluation, the individual of 1h30, the other in group of 3h in relation with the SUW.

6 lectures of 1h30

Lecture 1 - Introduction: issues, actors, stocks and flows, operating and renewal cycles
Presentation of the digital and ecological transition issues, presentation of the objectives, the actors (shareholders, employees, customers and other stakeholders) and resources (capital, work, knowledge) of the company as well as the diversity of the companies, distinction between exploitation and renewal, presentation of management methods (political, strategic, organizational, operational)

Lecture 2 - The marketing approach: studies, decisions, operations
Different types of markets and customers, strategic marketing: segmentation and positioning, external analysis (threats / opportunities) and internal analysis (strengths weaknesses), model PESTEL, conduct a market study, understand the behavior of the consumer, design a marketing plan, targeting and positioning, the 4P of the marketing mix (product, price, promotion, position, distribution), operational marketing, support of the commercial function, digital marketing, 4C model.

Lecture 3 - Growth methods and strategic maneuvers: supply chain, global value chain
Strategic development (diversification, outsourcing, globalization) and growth methods (internal, external / alliances), introduction to the analysis of value chains, concept of value creation, externalities and social cost.

Lecture 4 - The Strategic Approach: Vision, Mission, Competition, Generic Strategies
Analyze the broader environment, Porter's 5 strengths, experience curve, generic strategies (volume / differentiation), construction of competitive advantage, analysis of resources and skills of the company.

Lecture 5 - Performance Management: Objectives, Budgets, Indicators
Relevance, efficiency, effectiveness, performance measurement, indicators, steering cycle, budget, scoreboard, social indicators, contract and objectives, psychological contract, Fordism, Toyotism, quality management, continuous improvement approach, procedures and bureaucratization, customer orientation, issues of transversality.

Lecture 6 - Innovation: from marketing new products to intensive innovation strategies
Product, process, organization innovation, incremental innovation, radical, exploitation and exploration, technological skills, from technology to market, approach to design and innovation, valuation model of innovation, creation and protection of the innovator's rent, business model and exploitation of innovations, digital breakage

Conference on Corporate Management (Leaders, Experts, Observers)
Presenter: Xavier Fontanet,

5 lab' sessions of 1h30
Scenario in TD: 1h30 (Management Committee)
Case Study 1: 1h30 (Case Market Positioning)
Case Study 2: 1h30 (Case Strategic Analysis)
Case Study 3: 1h30 (Case Value Chain)
Case Study 4: 1h30 (Intensive Innovation Model Case)

Evaluation sessions during the Start Up Week

Session 7 - Speaker 1h30 / Individual Exam Enterprise Analysis 1h30
Session 8 (TD of 3 hours per group of 4 start-ups, 20 facilitators, file to be submitted): identification and analysis of the large company most likely to be "interested" (in a strong sense: to have an interest) in the development the offer of my start up, as a customer, supplier, partner, shareholder or biggest obstacle, how to understand its interest and ways to get closer to it ...

Grading

• Continuous monitoring: preparation and participation of 4 case study sessions (1/3)
• Collective report: collaboration with my start-up (1/3)
• Final check: individual written examination without document of 1h30 (1/3)

Course support, bibliography

A book and case studies specifically written for the class (with a list of additional readings) is made available to the student.

Resources

· Teaching staff (instructor(s) names): Eléonore Mounoud (CentraleSupélec), Marie-France Crévecoeur (VP Philips lighting), Ludovic-Alexandre Vidal (CentraleSupélec), Jérôme Billé (ASRC), Maxime Guymard (RTE), Xuan Nguyen (EDF)
· Maximum enrollment (default 35 students): 1 session Amphi + TD (12 TD for 400 students), 1session in integrated classes of 50 students (8 groups for 400 students)
· Software, number of licenses required: none
· Equipment-specific classrooms (specify the department and room capacity): none

1SL3000 – Quantum and Statistical Physics

Instructors: Jean-Michel GILLET
Department: PHYSIQUE
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 50
On-site hours (HPE): 32
Quota :

Description

The ambition of this course is to build the foundations of 21st century physics as they were formulated at the beginning of the 20th century (except for relativity). In doing so, we aim to show how models were elaborated, starting from experimental results, firstly, by trying to use the tools of the old theory, then by reconstructing axiomatically a new theory. This is done initially on mechanics and electromagnetism leading then to quantum theory. In a second time, a better understanding of the foundations of thermodynamics lead to the elaboration of statistical physics. The focus is always on applications or the impact of the introduced concepts on the fields where the engineer (or, simply, the citizen) is active.
Ultimately, the goal is to give a better acquaintance of engineering students to the conceptual contributions of physics on which many current innovations are developed. The students will master the vocabulary, will be familiar with some essential steps for an enlightened implementation and will know the limits of applicability.

Quarter number

SG3 and ST4

Prerequisites (in terms of CS courses)

Differential equations, linear algebra, vector spaces, thermodynamics, electromagnetism.

Syllabus

I. Period 1
1) Experimental puzzles (1h30)
(i) TD : Orders of magnitude in quantum physics (1h30)
2) From phenomenology to an axiomatic formulation
a) Schrödinger equation and Piecewise potentials (1h30)
(i) TD : Infinite wells (1 et 2D) potential steps (1h30)
(ii) TD : Tunnel effect and Microscopy (1h30)
b) Postulates and the mathematical artillery (1h30)
(i) TD : Quantum measurements and cryptography (1h30)

3) The quantum- classical fuzzy border (1h30)
(i) TD : Modelling of the alpha-radioactive lifetime (JWKB) (1h30)
a) Vibrations and perturbations (1h30)
(i) TD : Quantum modelling of NH_3 flipping and MASER effect (1h30)
Multiple choice test 15 mn
II. Period 2
b) Rotation, spin and the nucleus (1h30)
(i) HW : NMR and Medical imaging (reading)
c) Stability of atoms and the periodic table (1h30)
(i) TD : From H to He (1h30)
(iii) HW (computing project) : From the atom to the molecule (1h30)
(iii) TD : Morse's potential or VdWaals forces (perturbations) and thermal expansion (1h30)
Multiple choice test 15 mn
2) Equilibrium statistics
a) Statistical physics from thermodynamics and information theory (1h30)
(i) TD : Paramagnetism and Curie's law (1h30)
b) Regulated systems of classical particles (1h30)
(i) TD : Equation of state of a real Van der Waals gas (1h30)
FINAL EXAM (1h30)

Class components (lecture, labs, etc.)
to complete

Grading
Two intermediate quiz and one final exam.

Course support, bibliography
Handout and textbook "Application-Driven Quantum and Statistical Physics" (Vol. 1 and 2, World Scientific)

Resources
Teaching staff (instructor(s) names): J-M Gillet, P-E Janolin, T. Antoni, B. Palpant, M. Ayouz, Z. Toffano, H. Dammak, Y. Chalopin, S. Latil, F. Bruneval, G. Schehr, J-C Pain, O. Poujade, P. Cortona, (I.Kornev)
· Maximum enrollment (default 35 students): 90, 50, 25
· Software, number of licenses required:
· Equipment-specific classrooms (specify the department and room capacity): 1 large amphitheater, 6 rooms of 90, 1 rooms of 50, 9 rooms of 25

Learning outcomes covered on the course
At the end of the course, on the one hand, the student are expected to know how to build and / or use an elementary quantum microscopic model. From the description of an environment and / or a simplified potential, he will be able to find the spectrum of energies and eigenstates. He will be able to predict a

temporal behavior of the quantum states as well as the probabilities of results of a measurement. For this he will have to implement the standard methods of resolution, resort to the most common approximation techniques (perturbations, variations, JWKB).
On the other hand, from a proposed quantum law (spectrum of energies and degenerations), the student must know how to choose the adapted approach of statistical physics which will lead him to predict the behavior of a targeted macroscopic property. Emphasis will be placed on the deduction of equations of state and the temperature behavior of macroscopic response functions.

1SL4000 – Corporate Accounting and Finance

Instructors: Maxime GUYMARD
Department: SCIENCES ENTREPRISE
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 20
On-site hours (HPE): 12
Quota :

Description

At the end of the course, the students will be able to understand and apply the basics of financial management of a company.

Quarter number

ST4

Prerequisites (in terms of CS courses)

Business Management

Syllabus

• Basics in accounting: Balance Sheet, Income Statement (P&L), Cash flow
• The parameters to monitor for the financial management of a company
• Put into practice: Team simulation game

Class components (lecture, labs, etc.)

4 lectures (1:30 each); Online team simulation game (14:00).

Grading

The final mark is composed of the results of the game simulations and the synthesis done at the end by the students.

Course support, bibliography

All documents presented during the lectures are available on line.

Resources

• Teaching staff (instructor(s) names): Maxime GUYMARD, Sylvain DUFOURNY
• Maximum enrollment (default 35 students): N/A
• Software, number of licenses required: Internet only
• Equipment-specific classrooms (specify the department and room capacity): No

ELECTIVES COURSES

1EL1000 – Electromagnetism

Instructors: Dominique LECOINTE, Hichem DAMMAK
Department: ELECTROMAGNETISME, PHYSIQUE
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The course is composed of two parts called bases and extensions (these parts are nested during the course). The bases correspond to basic concepts used in several “dominantes”. In this course, extensions are associated to either guidance and antennas or optics and photonics.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

1- *Introduction*:
Electromagnetism is present in many industrial sectors. An example of an industrial sector with high technological value is introduced and the diversity of positions where electromagnetism intervenes shown. We shall also show the diversity of problems. The content of the course shall be explained and the common thread between the parts of the course exposed. We shall point out the concepts and applications that students will see in the basics through selected examples (propagation, guidance, emission, different scales ...). The place of the course shall be exposed within the new curriculum (present the courses where this course will be useful)
2- *Radiation* (Extension):
Electromagnetic wave sources: retarded potentials, far-field approximation, dipole approximation. Radiated field: local plane wave structure.
Introduction to diffusion by one or more ordered diffusers.
Application: Radiation by a mobile-phone antenna (wire).

3- *Equations of an electromagnetic problem on the macroscopic scale*:
Present the three pillars of electromagnetism. First pillar: Maxwell's equations valid for any medium: use of averaging to establish macroscopic Maxwell equations. Second pillar: constitutive equations of matter. Dielectric constant. Notions of homogeneity, linearity, isotropy, dispersion. Links betweendispersion and inertia, between phase shift and dissipation. Explanation of the constitutive equation in the case of basic and simple media (dielectric, conductor, magnetic medium, Drude model). Third pillar: Interface continuity conditions. Links with numerical tools (tools based on different methods: methods derive from a work to solve the equations of pillar 1, pillar 2 appears as a catalog of models available to the user)

4- *Synthesis and applications:*
The different types of problems: objective, associated hypotheses and simplification, iconic applications. Static: electrostatics, magnetostatics. Phenomenon dependent on time: time domain, complex domain. Quasi stationary states. Refraction and reflection phenomena at an interface, total reflection, evanescent wave, Brewster angle. Diffraction.

5- *Free propagation in a medium:*
Properties of the monochromatic plane wave. Propagation in an absorbing, dispersive and plasma medium. Power exchanges with the medium. Application: From the plane wave to the parallel blade guide.

6- *Basic principles of imaging (Extension)*:
Propagation: near field, far field, evanescent waves, diffraction and self-diffraction of a wave, resolution limit. Application : Optical image processing.

7- *Guided Propagation:*
Theoretical development from Maxwell equations of reflection and transmission properties. TE, TM, TEM modes. Metal guides, dielectric guides, optical fibers. Application: Anti-reflection treatments (thermal windshield, anti-reflective glass, ...)

8- *Nanophotonics and metamaterials* (Extension):
Photonic crystals. Negative index structures, flat lenses. Application: Guidance by a 2D photonic crystal

9- *Guidance structure and line theory* (Extension):
From TEM to the theory of lines. Theory of lines. Technology, supply of guide structures. Application: Transition guide line for microwave weapon.

10- *Antennas (*Extension):
Presentations of examples. Return on the characteristics starting from the theoretical formulas of the radiated field (cf 2). Antenna technology. Definition and characteristics of an antenna by an experimental approach: radiation zones, radiation pattern, gain and directivity, equivalent surface of an antenna, input impedance or reflection coefficient. Application:
Vehicle Wiring Network: Line Theory
Radiation diagram, input impedance of an on-board antenna.

11- *Environmental and societal issues*:
Electromagnetic pollution: electromagnetic compatibility Electromagnetic pollution: exposure of people

Class components (lecture, labs, etc.)

14 lessons of 1h30, 5 TD of 1h30, 3 TD Numeric of 1h30 et 2 written exams of 1h30

Grading

Two written exams of 1h30 without documents.

The ponderation between the two exams is 0.5 /0.5

Course support, bibliography

Course and Exercises books. Corrections of exercises.

Resources

• Teaching staff (instructor(s) names): Hichem Dammak, Alain Destrez, Pierre-Eymeric Janolin, Dominique Lecointe, Bruno Palpant, Dominique Picard

• Maximum enrollment (default 35 students): 3 TD rooms of 35 for standard TDs. 4 TD rooms with 25 stations for the 3 Numerical TD (TD6 TD7 and TD8).

• Software, number of licenses required: MWS software.

Learning outcomes covered on the course

At the end of this lesson, the student will be able to:

- Apply the required approximations according to the wavelength, the size of the system and the distance at which the phenomenon is observed: diffraction of an EM wave or radiation of an antenna (C1.2/1)

- Identify the radiation area and directivity of an antenna.

- Describe whether a medium is transparent, absorbent or opaque from its dielectric or optical properties.

- Apply the boundary conditions for a system with one or more interfaces.

- Calculate the reflection and transmission coefficients of an EM wave through an interface.

1EL2000 – Electrical Energy

Instructors: Jean-Claude VANNIER
Department: ENERGIE
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

Electrical energy is indispensable to the functioning and development of society all across the globe. Over 100 years of continuous progress has allowed its integration into new sectors (ground, maritime, and aerial transport, onboard systems, renewable energy, spatial). Presently, environmental and sustainable development objectives have motivated further progress in the technology at different power levels. This course on electrical energy aims to provide students with the fundamentals and methods used for the analysis of systems using electricity as an energy vector. The course associates knowledge of physics and magnetic materials for the characterization of the elements which constitute electrical energy systems. To start with, the course touches on major actors and global issues associated with the use of electrical energy for the functioning of society, with an emphasis on the pertinence of different scientific disciplines. Next, the course presents the principal concepts and tools needed for the analysis of electrical systems along with examples for their application. The course focuses on the importance of understanding magnetic coupling in electrical systems using the laws of electromagnetism. The behavior of the associated magnetic materials and their analysis is then applied to establish models for the systems in order to better understand their performance at different levels of excitation or frequency. The representation of typical magnetic circuits is then used to give students better understanding of how the physics associated with elements of the systems may be used to develop a system model. The natural application of the principals learned by students in the first parts of the course is the study of transformers and inductively coupled systems. Afterward, the conversion of electrical into mechanical energy will be formalized using the principal of virtual work based on magnetic energy associated to magnetic coenergy for the formulation of forces and torques produced by motors and generators. An application of electrical to mechanical energy conversion, the direct current machine, will then be presented in order to provide students with the basis for understanding the principals of motorization or electrical generation at variable speed.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)
None

Syllabus
Introduction to electrical power engineering
Omnipresence of electrical engineering: production, transport, conversion, utilization and control of electrical energy. Multi-physical and economic aspects.

Transport and consumption of electrical energy
Single phase and three phase systems, definition and calculation of electrical power. Equipment sizing and power factor.

Physics associated with electrical power engineering
Electromagnetism applied to electrical power engineering. Magnetic materials, creation and channeling of magnetic fields, permanent magnets. Modeling methods, magnetic circuits, reluctance and electromotive force. Taking into account power losses associated with magnetic circuits.

Principals of magnetic coupling
Notions of magnetic flux and leakage flux. Partial and total leakage inductance. Modeling of magnetic coupling.

Single and three phase transformers
Function and structure; ideal transformer; modelling of a real transformer, transformer operation at 50 Hz and influence of variable frequency; construction of magnetic circuit, insulation and conductors.

Electro-mechanical conversion
Link between electrical, magnetic, and mechanical energy. Systems with moving parts; calculation of forces and torques; resistive torque.

Direct current machine
Principal and structure/construction. Fundamental equations. Excitation modes. Problems associated with operation. Principles of control with variable speed. DC brushless motor.

Class components (lecture, labs, etc.)
CM(1-6) // TD1-EL(7-10) // CM(11-12) // TD2-EL(13-16) // CM(17-18) // TD3-EL(19-22)// EE(23-24)

Grading
The evaluation will be done by a written examination of 3h with a part of 1h without documents followed by a part of 2h with documents.

The TPs will be taken into account in the final grade of the module.
Absence at a TP will give the mark 0/20 to the TP.

Course support, bibliography

Text provided by the teaching group.
Electrical Machines, Drives and Power Systems (Theodore Wildi, Prentice-Hall Intl)

Resources

• Teaching staff : Martin Hennebel - Michael Kirkpatrick - Pierre Vidal – Jean-Claude Vannier
• Maximum enrollment (default 35 students): 25
• Software, number of licenses required:
• Equipment-specific classrooms (specify the department and room capacity): Energy department teaching laboratory for TP.

1EL3000 – Industrial Engineering

Instructors: Ludovic-Alexandre Vidal, Julie LE CARDINAL
Department: SCIENCES ENTREPRISE
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

• Know the issues and stakes of firms and organisations, their products and services, and their relationships with innovation, economy and human societies.
• Understand the multidisciplinary and complex character of firm-oriented systems along the lifecycle of an organization (design, industrialisation, production, distribution, reliability and return on experience,…).
• Understand how the choices made to determine the strategy for products/services development is a compromise between many constraints : availability of resources and skills, competition, environmental impact, organizational culture and strategy,…
• Understand and use the fondamental concepts, models and tools (and their application through several examples) which are used internationally in the field of industrial enginnering (academic world and industrial practitioners).

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

This course includes two cases (one which is product-based – for instance automotive industry –, and one which is service-based – for instance a hospital) to illustrate the different concepts.

Sessions :
Session 1 : Life Cycle of an Organization / a Product / a Service Life Cycle Concept, Stakeholders and Values, Systems Thinking, Main Phases and Processes.
Session 2 : Design Processes - 1 Design Processes and Activities, Functional Analysis, Specifications.
Session 3 : Design Processes - 2 Life Cycle Analysis, V-Cycle, Design Flexibility, Produc-based FMECA.

Session 4 : Industrialisation Processes Process Representation, Industrialisation Decisions, Digital Factory, Engineering Contracts, Industry of Future.
Session 5 : Production Processes - 1 Make-to-Order Approaches, MRP and Associated Mathematical Models.
Session 6 : Production Processes - 2 Make-to-Stock Approaches, Kanban, Associated Mathematical Models.
Session 7 : Distribution Processes - 1 Stakes of Distribution Activities, Distribution Monitoring and Control, Distribution Performance, Stock, DRP.
Session 8 : Distribution Processes - 2 Warehouses and Cross-Docking Models, Flows & Vehicle Route Optimisation, Supply Chain Sustainability and Performance, Tracking.
Session 9 : Quality Processes Product Reliability, Reliability Funcitons, Reliability and Safety Analysis Parameters, Bathtub Curve, Reliability of Parallel or Series Components.
Session 10 : Maintenance Processes Maintenance of Industrial Organizations, Immobilization costs, Equipment Renewal.
Session 11 : Industrial Conference (3h) Synthesis of all sessions with an industrial conference.
Session 12 : Final Test (3h) Final Test.

Class components (lecture, labs, etc.)
Each session (3h) is divided into :

- A 1h30 auditorium conference.
- A 1h30 work session with 60 students group to use the concepts and tools presented during the auditorium conference.

Grading
3 intermediate controls will take place during the course.
The score of continuous (intermediate) controls will be worth 50% and that of the project 50%.

Resources
Teaching staff (instructor(s) names): Ludovic-Alexandre VIDAL, CS Associate Professor. Julie Le Cardinal, CS Professor. Ph.D. Students and/or teachers from CS Industrial Engineering Research Department.
• Maximum enrollment (default 35 students): 50
• Software, number of licenses required: Edunao
• Equipment-specific classrooms (specify the department and room capacity): none

1EL4000 – Materials

Instructors: Véronique AUBIN
Department: MÉCANIQUE GÉNIE CIVIL
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

- To make 1st year students aware of materials issues and their importance in society, economy and innovation
- - Open them to the multidisciplinary nature of the world of materials and make them aware of the scientific and technological barriers around materials (e.g. aeronautics, fuel cells, ITER, electronics beyond Moore's law, energy recovery and transformation, materials for health, biomaterials, MEMS-NEMS,...)
- - Show that the choice of a material results from a compromise within a set of constraints: availability of resources, production processes, use properties, life cycle, environmental impact and cost
- - To make understand the physical phenomena at the origin of the properties of materials, to propose, through some examples, simple models which capture the essential of the physics of the phenomena and tools which make it possible to apprehend these phenomena, and to give the desire to deepen in more fundamental courses thereafter

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

• Introduction: current importance of materials, challenges associated with materials in major societal issues
• Introduction to the main families of materials: definition based on the nature of the chemical bond, resulting and use properties, introduction to the choice of materials
• Structures and phase transformations of materials:
o Order-disorder concepts: from crystal to amorphous via polymers and liquid crystals and how to describe and measure order and disorder

o Defects (0D to 3D): crucial role of the defect in the materials, illustration by various couples defect / property
o Thermodynamic balances and phase diagrams, their role in materials development
o Phase transformation kinetics: how heat treatments optimize material properties.
• Material properties
o Mechanical properties related to the structure: plastic deformation mechanisms, material breakage and ruin
o Functional properties related to the structure: thermal and electrical conduction, ferroelectricity, magnetism, optics

Class components (lecture, labs, etc.)
(1 session = 3 hours lesson)

- Session 1 and 2 : lecture + directed study session
- Session 3 and 4 : lecture
- Session 5 to 8 : lecture + directed study session
- Session 9 and 10 : lecture
- Session 11 and 12 : working session

Grading
Continuous monitoring during the course (3 evaluations) for 50% of the final grade, summary document of the 2 working sessions for 50% of the final grade

Course support, bibliography
Materials of M. Ashby and D. Jones, Introduction to Solid State Physics of C. Kittel

Resources
• Teaching staff (instructor(s) names): Brahim Dkhil, Hervé Duval, Véronique Aubin, Camille Gandiolle, Elsa Vennat, Pierre-Eymeric Janolin, François Puel, C. Toffolon, S. Guéneau
• Maximum enrollment (default 35 students): 35 students
• Software, number of licenses required: CES Edupack, 100 licenses
• Equipment-specific classrooms : none

1EL5000 – Continuum Mechanics (MMC)

Instructors: Guillaume PUEL
Department: MÉCANIQUE GÉNIE CIVIL
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The student should be convinced of the ubiquity of the concepts and tools of mechanics in any industrial project implying either basic or advanced technology. The basic concepts are introduced in a common unified framework for deformable solids and fluid flows. Problems involving mechanics at different scales illustrate the course, with some applications to civil engineering, transportation, biomechanics and nanotechnology typically.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

1. Strain: lagrangian description of movements, Green-Lagrange strain tensor, infinitesimal strain tensor
2. Stress: global equilibrium equations of a material medium, Cauchy stress tensor, local equilibrium equation
3. Resistance criteria: mechanical tests, brittle fracture criteria, Tresca and von Mises criteria, stress concentration
4. Mechanical behaviour of materials: diversity, linear elastic isotropic behaviour, thermoelasticity
5. Linear elasticity: properties of the mechanical solution, exact and approximate solutions, simplifications of an elastic problem
6. Special session: short intermediary examination (45 min) + practical problem to improve modelling skills (hypotheses, boundary conditions, approximate solutions, …)
7. Numerical session 1 (Comsol Multiphysics): numerical solutions of elasticity problems focusing on: - complementary illustrations on the special session on modelling skills - numerical investigation on slender structures (preparations of sessions 8 and 9)
8. Slender structures: approximate kinematics, generalized forces and

moments, constitutive relation (illustration on a straight beam)
9. Practical session on slender structures
10. Viscous fluid behaviour: eulerian description of movements, strain rate tensor, viscous fluids and Navier-Stokes equation
11. Numerical session 2 (Comsol Multiphysics): numerical solution of a multiphysics problem (e.g. MEMS simulation)
12. Final examination

Class components (lecture, labs, etc.)
Typical 1h30 lectures followed by 1h30 tutorial classes, except for sessions 6, 7, 9 and 11 (3h-sessions of practical work)

Grading
Overall grade = 20% intermediary examination grade + 80% final examination grade with document

Course support, bibliography
Lecture notes

Resources
• Teaching staff (instructor(s) names): Andrea BARBARULO, Didier CLOUTEAU, Ann-Lenaig HAMON, Guillaume PUEL
• Maximum enrollment (default 35 students): 35 for each tutorial class
• Software, number of licenses required: Comsol Multiphysics (including the Structural mechanics module)
• Equipment-specific classrooms (specify the department and room capacity): none (numerical sessions with Comsol are taught in classical tutorial classes)

Learning outcomes covered on the course
Learning outcomes:
• Model the mechanical behaviour of a deformable solid or a flowing fluid

Justify the relevant choice of model (2D or 3D, axisymmetry, slender structures, ...)
Write the correct equations and boundary conditions corresponding to the loads and constraints applied to the domain and its boundaries
Identify the mechanical properties of constitutive materials that are relevant to model the studied problem (e.g. rigidity, viscosity, resistance, …)

• Determine the (stationary) mechanical response of a deformable solid or a flowing fluid

Find the exact solution or an approximate solution (analytical or numerical) of the studied problem

Deduce from the obtained solution the quantities allowing to make design choices

Justify or criticize the validity of the obtained solution

1EL6000 – Networks and Security

Instructors: Jean-Francois LALANDE, Eric Totel, Guillaume Piolle, Valerie Viet Triem Tong, Frederic Tronel, Guillaume Hiet, Christophe BIDAN
Department: CURSUS SUPÉLEC - RENNES
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

This elective course aims to provide CentraleSupélec students with basic knowledge in computer networking, as well as a reasonable awareness of information security issues.
Regarding networking, the mechanisms allowing users like us to browse and use Internet services will be highlighted. Thus, the various networking layers, from the physical to the applicative level, will be introduced, as well as additional network services such as DNS (Domain Name Service).
Hands-on and tutorial sessions will allow students to face the actual implementation of the various concepts covered, in realistic situations and systems.
Regarding information security, lectures will introduce fundamental concepts and will succintly present a few security mechanisms. They will be complemented by lab sessions illustrating various security risks and the associated countermeasures.

Quarter number

SG1 and SG3

One occurrence in french in SG1, one occurrence in french and one in english in SG3

Prerequisites (in terms of CS courses)

Information system and programming,
knowledge of a programming language (Python, Java, C++...)

Syllabus

Part 1: Networking – lower layers (lecture: 3h)
- Physical layer / data link layer (Ethernet and 802.11)
- Address Resolution Protocol (ARP), Media Access Control (MAC) addresses

Part 2: Networking – intermediate layers (lecture: 3h – tutorial: 6h – lab: 3h – personal work: 9h)
- IP protocol and addresses
- IP routing and routing protocols
- Transport protocols (TCP and UDP)
- Tutorial 1: Network traffic analysis (Wireshark)
- Tutorial 2: Specification of a communication protocol
- Lab 1: Networking equipment handling (routers / switches)
- Personal work: Border Gateway Protocol (BGP), peering, IPv4-IPv6 migration, congestion control, flow control, QoS...

Part 3: Networking – Applicative layers and services (lecture: 3h – tutorial: 3h – personal work: 9h)
- Domain name resolution (DNS)
- HTTP protocol, web technologies
- Tutorial 3: Implementation of the protocol specified in tutorial 2, in Python (socket programming)
- Personal work: e-mail protocols (IMAP, POP, SMTP), directories (LDAP)...

Part 4: Information security (lecture: 7h30 – lab: 6h – personal work: 10h)
- Introduction to information security, fundamentals
- Legal and social aspects
- Introduction to cryptography and cryptographic protocols
- Introduction to malware
- Lab 2: Virtual Private Networks (VPN)
- Lab 3: Web application security
- Personal work: IPSec, DNSSec, TLS, secure instant messaging, firewalling...

Class components (lecture, labs, etc.)

Networking – lower layers : lecture 3h
Networking – intermediate layers : lecture 3h tutorial 6h lab 3h Personal work 9h
Networking – Applicative layers and services : lecture 3h tutorial 3h Parsonal Work 9h
Information security : lecture 7h30 lab 6h Personal Work 10h
Exam 1h30

Grading

The evaluation will be done by a written examination at the end of the session lasting 1h30
50% final exam (written, no documents)
50% lab sessions

Course support, bibliography

Transparencies made available to students and bibliographical suggestions during class.

Resources

* Teaching staff: Rennes/CIDRE team members, as well as Paris-Saclay teachers for tutorials and lab sessions;

* Maximum enrollment: 100, in four lab/tutorial groups of 25;

* Software used: Wireshark, Python, VirtualBox, OpenVPN (all free/open source);

* Equipment-specific classrooms: Lab session 1 will take place in a classroom equipped with dedicated networking equipment, other labs and tutorials take place in standard PC classrooms or on personal computers;

* Some lectures may be presented remotely from Rennes.

1EL7000 – Introduction to Mass, Momentum and Heat Transfer

Instructors: Hervé Duval, Fabien Bellet, Gabi-Daniel Stancu, Ronan VICQUELIN
Department: ENERGÉTIQUE, PROCÉDÉS
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The objective of this course is to teach the basic notions of mass, species, momentum and heat transfer necessary to the characterization and scaling of multiple systems. Due to the strong analogy between species transfer and heat transfer on the one hand and the intimate coupling between fluid dynamics and heat transfer inherent to the convection phenomenon on the other hand, this set of engineering sciences is very consistent and is part of the basic academic core in a large variety of industrial sectors covering energy (nuclear, fossil, renewable), transport (automobile, aircraft, aerospace), industrial processes (chemical, biomedical), health, building, … Moreover, a good knowledge of these transfer sciences is absolutely necessary in the booming domain of the optimization of industrial processes. Finally, several current environmental issues and challenges for society such as the reduction, the dispersion or the sequestration of pollutants or the climate change involve physical phenomena partly based on transfer sciences. To solve all the serious problems that humanity is facing in the beginning of this 21st century, many important developments and breakthroughs will have to be achieved in the domains of technology, health and environment. In this context, a good background in mass, species, momentum and heat transfer is a major advantage for engineering students, and this set of sciences is essential for the training of high level engineers. The course is composed of a dense theoretical content (mass and species transfers, fluid dynamics, heat transfer by conduction, convection and radiation in diverse configurations: steady-state or transient, isolated or coupled phenomena, boundary layers), and after each lecture a practical engineering problem illustrating the notions introduced is solved in tutorial classes.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

Basics of mathematics and thermodynamics (studied during the first 2 university years)

Syllabus

• Session 1 Lecture THE BASICS OF HEAT TRANSFER: Conduction, convection, radiation. Introduction to the conduction transfer coupled to convection (fluid flowing along a wall). First energy balance equation (steady-state regime – motionless and non-deforming solid). Electrical analogy.
o Tutorial Thermal Insulation of a cryogenic container
• Session 2 Lecture THE BASICS OF RADIATION HEAT TRANSFER: Notions of opaque body and of transparent medium. Notions of emitted, absorbed, reflected, leaving, incident and radiative heat fluxes. Writing boundary conditions involving radiative heat exchanges. Notion of spectral directional intensity. General expression of a radiation heat flux. Notion of equilibrium radiation – Properties of the associated spectral intensity.
o Tutorial Principle of infrared remote sensing
• Session 3 Lecture RADIATIVE PROPERTIES AND RADIATIVE TRANSFER: Characterization of the surface of an opaque body: notions of emissivity, absorptivity and reflectivity. Notions of gray surface, black surface, and surface with isotropic radiative properties. Simple models of radiative transfer between 2 opaque bodies separated by a transparent medium: (1) opaque, convex and isothermal body surrounded by an isothermal black body; (2) opaque, convex, isothermal and small body surrounded by an opaque isothermal enclosure.
o Tutorial Temperature of a surface submitted to the solar radiation
• Session 4 Lecture THE BASICS OF MASS TRANSFER: Analogy between heat and mass transfers. Species absolute velocity, mixture mass-average velocity, diffusion velocity. Fick's law (binary mixture, dilute gas or liquid). Physical origins, order of magnitude of the mass diffusivity. Mass diffusion equation. Boundary conditions – Discontinuous concentrations at interfaces.
o Tutorial Solar desalinization
• Session 5 Lecture INTRODUCTION TO THE STUDY OF FLUID FLOW: Types of flows. Description of motion and material derivative. Velocity and acceleration of a fluid particle. Transport theorems. General local balance of mass and species.
o Tutorial Ignition of an aeroengine combustor
• Session 6 Lecture BALANCE OF MOMENTUM: General motion of a fluid particle. Strain rate tensor. Stresses in fluids. Relation between stress and strain rate tensors in Newtonian fluids. Local balance equation of momentum. Euler equations. Navier-Stokes equations.
o Tutorial Pumping liquids using a conveyer belt
• Session 7 Lecture ENERGY BALANCE EQUATIONS: Local balance equation of kinetic energy. Local balance equation of energy. Bernoulli theorem and applications. Macroscopic balance of mechanical energy. Study of incompressible flows in pipes. Friction head losses. Moody diagram. Singular head losses.
o Tutorial Power regulation device for a hydraulic power plant

• Session 8 Lecture MACROSCOPIQUES BALANCES: Macroscopic balance of mass and species. Momentum theorem in steady flows. Moment of momentum theorem. Application to the determination of hydrodynamic forces and moments. Thrust of turboengines et rockets. Macroscopic balance of energy.
o Tutorial Flow diversion through a blade grid
• Session 9 Lecture PHYSICS OF MECHANICAL BOUNDARY LAYER: Boundary layer theory. A priori estimates of the laminar boundary layer thickness. Separation and transition. The boundary layer equations for a laminar flow over a flat plate. Approximate and exact solutions of the boundary layer equations for a laminar flow over a flat plate. Effects of pressure on boundary layers.
o Tutorial Boundary layer along the wing of a glider
• Session 10 Lecture EXTERNAL FORCED CONVECTION – 2D MECHANICAL AND THERMAL BOUNDARY LAYER MODEL: Rewriting the mass and momentum balance equations, and addition of the heat balance equation. Simplifying assumptions and simplified equations. Demonstration of the general form of an external forced convection correlation. Derivation of the expression of this correlation via the integral method (laminar flow).
o Tutorial Freezing of a mountain road
• Session 11 Lecture NOTIONS OF INTERNAL FORCED CONVECTION: Elementary notions on the mechanical and thermal entrance zones and on the fully developed mechanical and thermal regimes. Notion of mean temperature (or mixture temperature). Expressions of the Nusselt number for laminar and turbulent flows and for a duct of circular cross-section. Case of non-circular cross-sections: notion of hydraulic diameter.
o Tutorial Biofilm contactor for water treatment
• Session 12 Final exam

Class components (lecture, labs, etc.)
See syllabus

Grading
3 hours long final exam

Course support, bibliography
• Provided course material
• Polycopié CentraleSupélec « Mécanique des Fluides» ; Tome I ; Sébastien Candel.
• « Transferts thermiques - Introduction aux transferts d’énergie » ; 5ème édition ; auteurs : Jean Taine, Franck Enguehard et Estelle Iacona ; Dunod, Paris, 2014.

Resources

• Teaching staff (instructor(s) names): Hervé Duval, Ronan Vicquelin , Gabi Stancu, Fabien Bellet
• Maximum enrollment (default 35 students): 100 per session, and 35 per tutorial class, which means 3 tutorial classes per session
• Software, number of licenses required: none
• Equipment-specific classrooms (specify the department and room capacity): none

1EL8000 – Electronic systems

Instructors: Philippe BENABES
Department: SYSTEMES ELECTRONIQUES
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

Analog and digital electronic systems are today ubiquitous in our lives, whether in the use of connected objects for domotic applications, in the areas of communication, transport and health, in the fields of defense and space, or in the billions of computers connected across the WEB.
Despite a constantly evolving domain (Moore's law), there are a number of constant fundamentals that are common to most systems no matter their complexity:
- interfaces with the physical world (sensors) and persons (display devices, HMI),
- processing of analog signals (filtering, wavelets, ... and soon neuromorphic systems),
- analog-to-digital conversion (with or without data compression) and digital-to-analog (transducers)
- digital processing units onboard or remote (HPC, cloud ...).
This course is conducted in a top-down approach to prepare students to specify and develop electronic systems from existing hardware components and software solutions.
Also, the principles and physical quantities related to the operation of these components are covered. Nevertheless, the microelectronic design and realization (i.e. Computer Aided Design and microelectronic technologies) will be addressed in more advanced courses to students who want to develop their skills in that field.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

- AE lecture 1: Understanding of the different electronic technologies and basic reminders

- AE lecture 2: Operational Amplifier-based diagram
- AE tutorial class 1: Simple circuits and ideal operational amplifier
- AE lecture 3: Electronics for signal processing
- AE lecture 4: Study of nonlinear circuits
- AE tutorial class 2: Active filtering based on operational amplifier
- AE lecture 5: Interface and sensors
- AE tutorial class 3: Predeterminations and electronic simulations for the Laboratory Study
- ADC lecture : Analog-to-Digital conversion
- DE lecture 1: Introduction to logic and digital components
- DE tutorial class 1: Discovering the Arduino
- DE lecture 2: Data representation, logic, gates, flip-flops
- DE lecture 3: Advanced functions, operators, state machines
- DE lecture 4: Processing unit architecture
- DE tutorial class 2: Implementation of FPGA Processing
- DE lecture 5: Complex system design: software vs. hardware solutions, design methodology and co-design
- DE tutorial class 3: Complex digital processing hardware systems (FPGA, SOC)

Class components (lecture, labs, etc.)

Course support, bibliography

Digital Design and Computer Architecture by David Harris Sarah Harris
« Foundations of analog and digital electronic circuits »
Anant Agarwal and Jeffrey H Lang
Morgan Kaufmann Publishers
http://siva.bgk.uni-obuda.hu/jegyzetek/Mechatronikai_alapismeretek/English_Mechatr/Electr_Eng-1/Literature/Foundations%20of%20AD%20Circuits.pdf

Resources

• Teaching staff (instructor(s) names): • Maximum enrollment (default 35 students): • Software, number of licenses required: • Equipment-specific classrooms (specify the department and room capacity)

1EL9000 – Thermodynamic

Instructors: Marie-Laurence Giorgi, Didier JAMET
Department: ENERGÉTIQUE, PROCÉDÉS
Language of instruction: FRANCAIS, ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 36
Quota :

Description

The objective of this course is to provide the theoretical bases, tools and good practices necessary for engineers to understand and design systems that transform raw energy into useful energy, and /or that modify the physico-chemical properties of matter through controlled transformations.
The knowledge covered in this course will allow to design these systems by searching their optimal operating points (for example by using phase transitions) in order to optimize their energy efficiency.
In particular, the course will show how thermodynamic concepts can be used to meet the challenges of the 21st century (conventional and renewable energy production, energy efficiency of engineering processes, smart materials, recycling, water and waste treatment, etc.) and how recent scientific advances, in particular nonequilibrium thermodynamics, can help predict multiphysical couplings in complex systems.

Quarter number

SG1 and SG3

Prerequisites (in terms of CS courses)

None

Syllabus

1) Energy efficiency (4 courses of 3hr each)
General description of the fundamental concepts (open systems, state functions)
Open systems of energy transformation (energy, entropy and exergy balance)
Efficiency of energy recovery cycles (design of thermodynamic cycles)
2) Phase transitions (4 courses of 3hr each)
Thermodynamic properties of pure substances and solutions
Phase equilibria, phase diagrams
Phase transitions (equilibrium and departure from equilibrium, chemical reactions, germination / growth)

3) Introduction to irreversible processes (1 course of 3hr)
Evolution towards stability, motion forces, coupling of irreversible phenomena

Class components (lecture, labs, etc.)
The course will be divided into 3 hours periods (1.5 hours of lecture and 1.5 hrous of tutorials).
At the end of each part of the course, students will work on an evaluation of the concepts covered: Two individual assessments will take place during periods 5 and 8.
The last three periods will be devoted to a project by 2 or 3 students (2 x 3 hours to realize the projec, and 3 hours to present all the projects)

Grading
Two individual assessments (30% each) and a final project in teams of two or three students (40%)

Course support, bibliography
D. Kondepudi, I. Prigogine, Modern Thermodynamics – From Heat Engines to Dissipative Structures, John Wiley and sons, England, 1998.
C.H.P. Lupis, Chemical Thermodynamics of Materials, Elsevier Science Publishing, New York, 1983.

Resources
• Teaching staff (instructor(s) names): Didier Jamet (CEA) Marie-Laurence Giorgi, Sean Mc Guire
• Maximum enrollment (default 35 students): 35
• Software, number of licenses required: open source software
• Equipment-specific classrooms (specify the department and room capacity):

LANGUAGE AND CULTURE COURSES

1LC0000 – Modern Languages, Cultures and Civilisation

Instructors: Claude MEZIN-WILKINSON
Department:
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 0
On-site hours (HPE):
Quota :

Syllabus

The study of English and one other modern language is compulsory. The second language may be chosen from: French as a foreign language (for non-native speakers of French), Arabic, Chinese, German, Hebrew, Italian, Japanese, Russian or Spanish. Language courses are also open to international students in semester- or year-exchange programs. We highly recommend they take French as a Foreign Language (FLE) at the appropriate level, with 2 ECTS per semester. Students from non English-speaking countries are advised to take English courses (2 ECTS per semester). Students who are already at the C2 level in FLE or English, and who have a TDC (Test de Dispense de Cours) may study another languagel.

1LC0100 – English

Instructors: Mark Pitt
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

Two courses per year, each lasting two periods, 1 and 2 and / or 3 and 4

Syllabus

General and thematic courses are on offer, depending on the level and the availability of the student

Class components (lecture, labs, etc.)

Student-centred active learning, flipped classroom, whole class or group activities. One hour minimum per week of homework to prepare or prolong in-class activities.

Grading

Continuous assessment (various spoken and written exercises) counting for at least 80% of the final grade

Course support, bibliography

Varied: audio and video, written documents, news articles, documentaries, works of Literature, English language textbooks, depending on the course taken.

Learning outcomes covered on the course

Consolidate and develop the four basic language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0200 – French as a Foreign Language

Instructors: Geraldine OFTERDINGER
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number
S5 and S7 from September to January S6 and S8 from February to June

Prerequisites (in terms of CS courses)
Minimum B1 level in French

Syllabus
Those weekly courses are offered at several levels, depending on the results of the placement test. Classes are organized as practical workshops focusing on oral understanding and communication, written understanding and communication, structural proficiency (grammar, vocabulary). Students will work individually or in groups on themes related to contemporary French culture in relation to its historical past.

Class components (lecture, labs, etc.)
A placement test will determine the level of the course: B1, B2, or C1 (European reference framework)

Grading
The evaluation is organized in two ways: continuous assessment and control of the end of half-year.

Course support, bibliography
Specific to each course and group level: printed documents (press, literature), audio/video (films, recordings), textbooks

Learning outcomes covered on the course
Develop and solidify the four language competences (written and oral comprehension, written and oral expression) to communicate in the academic, professional and/or personal environments Develop and solidify the tools of intercultural understanding to allow students to engage in the discovery of the culture Allow students to develop their learning process in

an autonomous and responsible wayOffer various innovative approaches suited to individual needs

1LC0300 – German

Instructors: Sabine GEISERT
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

A variety of courses are on offer, depending on the level of the student. From a level B2 and up, students may choose a thematic course (economics, scientific, history, cultural, etc.). All courses include grammar, structure exercises, and work on oral and written skills

Class components (lecture, labs, etc.)

Following a test, students are place in a level group. Lessons are 1.5 hours long per week in the CS curriculum. Dans le cursus Centralien, 2 cours (3h) par semaine pour des niveaux A1-A2

Grading

CS: Continuous assessment (various spoken and written exercises) counting for at least 80% of the final grade.

Learning outcomes covered on the course

consolidate and develop the four basic language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0400 – Spanish

Instructors: Maria-Dolores SOLER-PARDINILLA
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number
S5 and S7 from September to January S6 and S8 from February to June

Class components (lecture, labs, etc.)
Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading
CS: Continuous assessment (various spoken and written exercises) counting for at least 80% of the final grade.

Learning outcomes covered on the course
Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0500 – Italian

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0600 – Portuguese

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0700 – Chinese

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (calligraphy, lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are (usually) 1.5 hours a week. A few mutualized groups are 3 hours (2x1,5hrs).

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0800 – Japanese

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (calligraphy, lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC0900 – Russian

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (calligraphy, lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC1000 – Arabic

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (calligraphy, lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

1LC1200 – Hebrew

Instructors: Claude MEZIN-WILKINSON
Department: LANGUES ET CULTURES
Language of instruction:
Campus: CAMPUS DE PARIS - SACLAY
ECTS:
Workload (HEE): 60
On-site hours (HPE): 42
Quota :

Quarter number

S5 and S7 from September to January S6 and S8 from February to June

Syllabus

General language course (beginner to advanced levels) focussing on: Oral understanding and expression (pronunciation, intonation, rhythm, lexicon, structures), interaction Written understanding and expression (calligraphy, lexicon, structures) Acquisition of the tools enabling successful communication Cross cultural awareness

Class components (lecture, labs, etc.)

Following a test, students are placed in level groups. Lessons are 1.5 hours long.

Grading

Continuous assessment (80%) and written exam / listening-speaking test at the end of each semester (20%)

Course support, bibliography

Varied: audio and video, written documents, press articles, documentaries, literat ure ...

Learning outcomes covered on the course

Consolidate and develop the four main language skills (reading, writing, listening and speaking) consolidate and develop intercultural skills and comprehension essential to an international career give students an awareness of language that will allow them to develop their self learning skills propose a varied and innovative approach to language learning

SCIENCE AND ENGINEERING CHALLENGE N°2 COURSES

To be described

SCIENCE AND ENGINEERING CHALLENGE N°4 COURSES

To be described