SYLLABUS

2019-2020

semesters 5-6

CENTRALE MARSEILLE

Chemistry – Chemical engineering

Alexandre Martinez
Head of theme at École centrale de Marseille

ECTS credits
5

Code for the TU
ING_1A_S5_CHIM
ING_1A_S6_CHIM

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
36	32	4	24			**96**

Language
French

Teaching team
Chemistry :
– Bastien Chatelet
– Didier Nuel
– Laurent Giordano
– Alexandre Martinez
– Alberto Insuasty
– Cédric Colomban
– Innocenzo De Riggi
Chemical engineering:
– Pierrette Guichardon
– Pascal Denis
– René Arnaud

Objectives

In chemistry:
– Discover the general principles of kinetics and chemical thermodynamics as well as the structure-property relationships of molecules
– Recognise reactive molecular entities
– Be familiar with and know how to use the general concepts of organic reactivity to investigate the kinetics and mechanisms of molecular transformations, predict selectivity and stereochemistry
– Investigate the electronic structure of organometallic complexes, the metal-ligand bond, be aware of the basic steps leading to transformations in organometallic chemistry

In chemical engineering:
– Know how to apply mass and energy balances, with and without chemical reactions, for a system in the steady state regime
– Be familiar with and know how to calculate the volume of ideal reactors (closed circuit, perfectly stirred, plug flow reactors) in simple cases.
– In the case of perfectly stirred reactors, know how to calculate the adiabatic temperature
– Learn about the transient regime
– Apply this knowledge to the distillation of a binary mixture
– Be aware of the thermodynamics of liquid/vapor equilibria
– Know how to scale a plate column in continuous and batch modes

Programme

Molecular structure:
1. Chemical and atomic – Electronic configurations – Lewis theory – Molecular geometry – Quantum model of the atom – Molecular orbitals – Hückel method
2. Formal chemical kinetics – Rate and order of reaction and rate constant – Kinetics of complex reactions (parallel, consecutive reactions) – Mechanistic – Thermodynamics of activation – Kinetic/thermodynamic control
3. Chemical thermodynamics – Standard state – State functions – Partial molar magnitudes – Reaction magnitudes – First principles and applications – Chemical potential – Second principles and evolution of chemical systems

Organic reactivity:
1. Steady-state stereochemistry (chirality) – Dynamic stereochemistry (conformational analysis)
2. Reactivity of alkanes and halogenoalkanes, reactive species – Nucleophilic substitution – Elimination
Electrophilic addition on alkene.

Organometallic chemistry:
1. Organometallic complexes – Electronic structure of complexes – Metal-ligand bond
2. Reaction mechanisms – Ligand substitution – Oxidative addition – Reductive elimination – Insertions and eliminations

1. Balance and reactors:
– Discovery of chemical engineering and unit operations
– Overall analysis of a manufacturing process
– Applying overall and partial balances without chemical reactions
– Applying overall and partial balances with chemical reactions
– Energy balance, with and without chemical reactions
– Introduction to reactors (process & technology)
– Specific case of ideal reactors

2. Distillation of a binary mixture:
– Introduction to separation methods
– Thermodynamics of liquid/vapor equilibria
– Flash distillation
– Continuous distillation: scaling by the McCabe and Thiele method
– Batch distillation: Rayleigh equation and scaling

Assessments

SE Chemistry (2/3) – Chemical Engineering (1/3): 50%
CA (Tutorial + Practical + Independent work) Chemistry (2/3) – (Tutorial + Independent work) Chemical Engineering (1/3): 50%

Bibliography

Online resources on the Ecole Centrale's teaching portal
Books (documentation center)

Economics Management

Dominique Henriet
Head of theme at École centrale de Marseille

ECTS credits
4

Code for the TU
ING_1A_S5_ECOG
ING_1A_S6_ECOG

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
						60

Language
French

Teaching team
– Dominique Henriet (Economic lessons)
– Renaud Bourlès (Economic)
– Mohamed Belhaj (Economic Management)
– Nicolas Clootens (Economic Management)

Objectives

This two-part course aims to present the principles of the general economic mechanisms and the economic and financial workings of companies. To understand the economic mechanisms requires knowledge of general modern microeconomic theory and models representing the law of supply and demand, its limitations and extensions. Similarly, the principles of company accounting are presented to highlight and explain the challenges associated with funding and exploiting companies. Finally, the course will cover the main principles of internal corporate organisation.

Programme

Economics
– Principles of microeconomics
  – general model, law of supply and demand and simple applications
  – market efficacy and failures (strategic behaviour and imperfections)
– Introduction to standard macroeconomic models
  – economic fluctuations and policies

Management
– Principles of company organisation and management
– Company accounting
  – review and accounting result, account balance and interpretation
– Financial analysis
  – funding sources and associated strategic challenges

Serious Game
– Role playing based on a market simulation

Skills

– Students will master complexity
– And be able to conduct programmes

Assessments

CC1 : DS 3 h (2 X 1 h 30) 85 % CC2 Serious game 15 %

Bibliography

Principles of microeconomics, G. Mankiw, Worth Publishers
www.dominique.henriet-mrs.fr
Polycopié de comptabilité

Computing

Thierry Artieres
Head of theme at École centrale de Marseille

Objectives
Programme
Skills
Assessments
Bibliography

ECTS credits
4

Code for the TU
ING_1A_S5_INFO
ING_1A_S6_INFO

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total

Language
French

Teaching team

Mathematics

Jacques Liandrat
Head of theme at École centrale de Marseille

ECTS credits
5

Code for the TU
ING_1A_S5_MATH
ING_1A_S6_MATH

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
36	36		24			**96**

Language
French

Teaching team
– G. Chiavassa
– T. Le-Gouic
– J. Liandrat
– C. Pouet
– F. Schwander
– J.-M. Rossi
– M. Tournus

Objectives
Introduction to the mathematical, numerical and probabilistic approaches required in general engineering

Programme
The TU is divided into three distinct parts:
– a theoretical analysis course addressing the bases of analysis: differential calculus, optimisation, Lebesgue integration, Fourier transforms, Hilbert spaces
– a numerical analysis course introducing the bases of numerical approximation: polynomial approximation, ordinary differential equations and approximation of their solutions, approximation of solutions to partial differential equations by finite differences
– a probability and statistics course as an introduction to the study of random situations: probabilistic tools, modelling, examples of applications in statistics. The following themes will be addressed: the basics of probability calculations, real random variables, transformations (characteristic function, generating function), series of random variables and convergence modes, pairs of random variables, point estimations and interval estimations, tests.

Skills
Skills targeted:
– know how to mobilise and use basic mathematical approaches
– know how to implement numerical methods to simulate a problem
– recognise a situation presenting a discrepancy and be capable of modelling it
– be capable of verifying the relevance of a model

Target field-related skills and knowledge
Bases of analysis and numerical analysis, probability theory, elements of parametric statistics

Assessments
Mini-tests at start of tutorials, multiple-choice questionnaires (30%), project (20%), supervised exercises (50%)

Bibliography
Course notes

Mechanics

Bruno Cochelin
Head of theme at École centrale de Marseille

ECTS credits
4

Code for the TU
ING_1A_S5_MECA
ING_1A_S6_MECA

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
26	28		18			72

Language
French

Teaching team
– Michel Benoit
– Stéphane Bourgeois
– Bruno Cochelin
– Thierry Désoyer
– Christophe Eloy
– Dominique Eyheramendy
– Marc Jaeger
– Olivier Kimmoun
– Cédric Maury
– Daniel Mazzoni
– Emmanuelle Sarrouy

Objectives

To present the concepts and tools related to the mechanics of continuous media (MCM)

This scientific discipline relates to the study of movement and the deformation of systems in response to the application of forces. These concepts can be used to model most mechanics problems encountered by engineers in applications. For example, we can cite the analysis of air flow around a windmill blade with a view to optimising its performance, the study of deformation and resistance of the same blades when exposed to extreme winds, and finally, the impact of acoustic disturbances generated by the windmill on the surrounding environment.

This course on the mechanics of continuous media (MCM) was designed to be a coherent foundation for all the advanced mechanics courses in the second and third years of the engineering degree. The basic principles of the discipline are presented to the highest level of current knowledge using a unified presentation which is valid for all macroscopic liquid and solid continuous media. Because it limits the number of essential notions, this vision is an effective teaching approach and prepares students to model complex mechanical systems with multiple physical characteristics at various scales.

Programme

The first part of this course is devoted to the general concepts of the discipline.
• Algebra and tensor analysis
• Basic concepts in MCM
• Deformation of continuous media: deformation tensors
• Efforts in continuous media: strain tensors
• General MCM equations: mass conservation, basic principles of dynamics, first and second thermodynamic principles

The subsequent part of the course relates to three key applications for engineers:
1) Linear elasticity
• From general MCM equations to elasticity equations
• Behavioural relation for a linear elastic solid
• Some analytical solutions to elasticity problems
• Notions of numerical solutions based on finite element methods

2) Fluid mechanics
• Adaptation of general MCM equations to the flow of incompressible fluids
• Newtonian fluid behaviour
• Solving classical fluid mechanics problems
• Hydraulic circuits

3) Linear acoustics
• From general MCM equations to acoustic equations
• Sound wave propagation, notions of acoustic modes

Skills

– Students will become familiar with a scientific discipline to create value and innovation
– Be able to understand, formulate and solve a multi-physical complex problem
– Be able to extend the field of knowledge to other disciplines

Assessments

1) Continuous assessment: tests completed during the 14 tutorial sessions, without documents:
– either a short 3-minute test at the start of the tutorial (worth 2 points)
– or a longer 30-minute test at the end of the tutorial (worth 20 points)
2) Classical written exam (three hours) "without documents"
3) TU grade = 60% written exam grade + 40% "long test" grade + average grade from short tests (maximum 2 points)

Bibliography

– Jean Coirier, Mécanique des milieux continus, 2nd edition, Dunod
– Paul Germain, Patrick Muller, Introduction à la Mécanique des milieux continus, 2nd edition, Masson
– Paul Germain, Mécanique, Volume I and II, École polytechnique, Ellipse
– Jean Salençon, Mécanique des milieux continus, Volume I and II, École polytechnique

Waves and signals

Miguel Alonso
Head of theme at École centrale de Marseille

ECTS credits
5

Code for the TU
ING_1A_S5_ONSI
ING_1A_S6_ONSI

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
30	26	12	24		4	**96**

Language
French

Teaching team
– Carole Deumie
– Gaëlle Georges
– Laurent Gallais
– Miguel Alonso
– Nicolas Sandeau
– Frédéric Lemarquis
– Salah Bourennane
– Caroline Fossati
– Thierry Gaidon
– Antoine Roueff

Objectives

Waves:
– Be able to model propagation in a real infinite homogeneous linear isotropic medium by implementing a Fourier transform
– Understand and use the wave packet concept (frequency-based and spatial)
– Apply these concepts to the study of interference, flat interfaces, and planar components
– Know how to define a polarisation state and understand the notion of propagation eigenstates in an anisotropic medium
– Understand the microscopic origins of the response of a physical medium under the influence of an excitation field
– Know how to implement the Fresnel approximation to describe propagation of a wave packet in free space
– Know how to describe crossing a lens in electromagnetic optics terms, and model an imaging system
– Understand the standard aberration concept and its consequences
– Know how to describe how an adaptive optical system functions

Signals:
– Become familiar with the physical nature of signals and the processes required for their digitalisation
– Be aware of and able to implement basic signal treatment methods
– Address the notion of optimal signal treatment and be familiar with a few optimal filtering techniques to deal with noise
– Perform a project relating to signal treatment
– Draw on the teaching provided to complete a signal-related multidisciplinary project or self-directed assignment

Programme

Waves: this course addresses basic concepts behind photonics (waves and wave packets, diffraction, image-formation). The proposed approach aims to achieve a smooth transition between the formalism of electromagnetic optics and that of image formation. Essential to this approach is the notion of a spatial wave packet, which can be used to treat propagation in free space as a filter applied to the space of spatial frequencies, and to reveal similarities in approaches relating to spatial and frequency-based components in an electromagnetic field. This methodology also specifically focuses on Fourier transforms, which is the mathematical tool upon which the approach was built. The concepts developed are illustrated through practical applications. The course is split into four sequences:
– fields and matter;
– interfaces, interference and planar components;
– wave packets in infinite space;
– images and imaging systems.
Signals: this course allows the identification of issues related to signal treatment and provides the basic concepts in this field. Signal treatment is one of the cornerstones of digital technologies. The course starts with a presentation of the principles of the scientific approach and new and specific techniques, for which industrial and societal applications are currently expanding. The main notions that will be addressed are the following:
– representation of linear systems;
– temporal and spectral representation of deterministic and random signals;
– linear filters;
– signal digitalisation and digital signal treatment methods.

Assessments

Continuous assessment:
CA1 waves: written + Practical (40%)
CA2 signals: written + Practical (40%)
Independent work (20%)

Bibliography

De l'Optique électromagnétique à l'Interférométrie – Concepts et illustrations, M. Lequime and C. Amra, EDP Sciences

Physics

Thomas Durt
Head of theme at École centrale de Marseille

ECTS credits
4

Code for the TU
ING_1A_S5_PHY
ING_1A_S6_PHY

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
36	18		18			72

Language
French

Teaching team
– Thomas Durt (quantum physics)
– Jean Bittebiere
– Marc Jaeger
– Nicolas Sandeau
– Philippe Réfrégier (statistical physics)
– Muriel Roche (statistical physics)
– George Bérardi (statistical physics)
– Frédéric Galland (statistical physics)
– Hassan Akhouayri (statistical physics)

Objectives

- Allow students to assimilate the basic postulates of quantum physics and understand, in particular, microscopic physics in probabilistic terms
- Provide students with notions of statistical physics and the basics of classical and quantum statistical distributions, as well as thermodynamic and chemical potentials
- Explain the changes to scientific reflections based on a history of ideas, mid-way between empiricism and speculation
- Provide students with the tools to identify implications for engineering

Programme

Quantum physics part:
– Limitations of a classical approach
- Wave particle duality
- Probabilistic description, basic postulates and measurement
- Description of angular, orbital and spin momentum
- Fermion/boson distinction
- Entanglement and non-locality
These concepts will be used with real-world examples, such as the hydrogen atom, harmonic oscillator, tunnel effect and quantum boxes.

Statistical physics part:
– Revision of probability as applied in physics
– Random steps and diffusion – Developing the foundational equations
- Basic principles and microcanonical and canonical distributions
- Sample applications
- Elements on grand canonical and quantum distributions
- Introduction to phase transitions

Skills

- Students will encounter an unusual conceptual framework, distinct from the intuitions formed at the macroscopic scale
- They will learn to handle non-determinism in physics and engineering
- And grasp the founding concepts in physics, which are useful in numerous scientific and technical fields

This teaching also allows students to practise:
-1 Identifying the determinant parameters necessary to solve a problem;
-2 Developing novel solutions;
-3 Demonstration of mathematical rigour when solving problems;
-4 Integrating a relatively complex means of reasoning.

Assessments

- 2-h continuous assessment in statistical physics, which accounts for 50% of the final grade
- 2-h continuous assessment in quantum physics, which accounts for 50% of the final grade
Note that two self-monitored and self-assessed mock exams are scheduled as preparation for the CA.

Bibliography

Quantum physics part: course notes. Introduction to Quantum Mechanics????, Griffith. Tutorial solutions and other solutions available on Moodle
Statistical physics part: books available from the school's library. Some handouts for tutorials

Languages and international culture

Carole Enoch
Head of theme at École centrale de Marseille

ECTS credits
2

Code for the TU
ING_1A_S5_BETA_LANG
ING_1A_S5_ALPHA_LANG
ING_1A_S6_BETA_LCI
ING_1A_S6_ALPHA_LCI

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
	40				20	**60**

Language
English

Teaching team
– German: Dominique Ortelli-Van-Sloun
– English: John Airey, Patrick Atkinson, Valérie Durbec, Gerald Marquis
– Spanish: Carole Enoch
– French as a foreign language: Valérie Hamel (+ French as mother tongue)

Objectives

Languages and culture (L&C) are essential elements in the training of internationally aware and responsible citizens and engineers.
Engineers graduating from Ecole Centrale Marseille must be able to interact precisely and effectively with partners in a number of languages and/or from different cultures, in particular in an occupational environment.
Graduates will be capable of mobilising linguistic, conceptual, cultural and communicational knowledge and skills. To do so, they will acquire information relating to practices, events and/or historical, cultural, social, economic and political phenomena. Their imagination will be stimulated through cultural exploration and by taking differences into account by varying their representations. They will develop their critical faculties.

Programme

L&C teaching includes two distinct branches of teaching: English (LL1) 20 h and another language 20 h (LL2). Please note: foreign students enrolled in a double diploma/degree will take two French as a foreign language courses (LL1 and LL2) in S5 and S6. These 40 hours' on-site lessons are complemented each semester by 10 h of personal work (independent work, research, exercises, etc.) for each language.
L&C are taught at a volume of 2 hours per week for each language. Students will be grouped by level following English, French as a foreign language, German and Spanish testing (if necessary). For beginner level LL2, students will have 10 hours (Italian, Spanish, Portuguese) or 15 hours (German, Chinese, Japanese, Russian) of complementary remedial lessons.
N.B. Students will only be able to start a new language in semester 5.

Levels and obligatory external certifications to validate the diploma/degree:
- In English and French as a foreign language, the desirable level following the course is C1 on the CEFRL.
In line with the Regulations of studies, all students must obtain an external certification in English (minimum level required B2+, or TOEIC 850).
International students must also validate a minimum B2 level on CEFRL in French as a foreign language (Delf B2 or Dalf C1 C2). Note: other students must validate a level of French as their native language (FLM/Orthodidacte level 3).
– For other languages, the target level is B2, or C1 depending on the student's academic trajectory. It is recommended that an external certification be obtained to certify the highest level obtained at the end of the training.
-> See the descriptions of the different levels in the Common European Framework of Reference for Languages (CEFRL): https://www.coe.int/en/web/portfolio/self-assessment-grid

Skills

– C1: Production + fluency
– C2: Represent and model + resolve and arbitrate + think and act in an unpredictable and uncertain environment
– C3: Design a project, a programme + manage, lead
– C4: Generate individual and collective performance + lead transformation of an organisation (identify needs / hurdles when effecting changes, etc.)
– C5: Anticipate and commit + construct and sustain (analyse an organisation's strategy with respect to local, global or other challenges)

Assessments

TU divided into two parts (CA1 LL1 50% + CA2 LL2 50%). A pass grade of 10/20 is set, with a minimum of 7/20 required to validate the course
Assessment of the five CEFRL skills: written comprehension and expression, continuous oral comprehension and expression in interaction + assessment of knowledge acquired (lexicon, conjugation, culture, etc.)
Attendance mandatory (maximum of two absences)

Bibliography

Specific to each language

Physical, sporting and artistic activities

Jean-Luc Blanchon
Head of theme at École centrale de Marseille

ECTS credits
1

Code for the TU
ING_1A_S5_BETA_APSA
ING_1A_S5_ALPHA_APSA
ING_1A_S6_BETA_APSA
ING_1A_S6_ALPHA_APSA

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
	15					**15**

Language
French

Teaching team
J.-L. Blanchon assisted by 15 contract teaching staff

Objectives
- Raise students' level of competence in the selected physical, sporting and artistic activity (PSAA)
- Demonstrate a strong commitment for oneself and for the "PSAA group"
- Effectively contribute to how a group or team works together
- Manage one's physical condition and maintain one's "health assets"

Programme
Each student selects an eligible PSAA for the semester.
Students are expected to participate weekly with their PSAA group.
The teaching will provide students with procedures allowing them to "increase their sporting or artistic skill level" and will encourage them to effectively and regularly implement these procedures.

Skills
During PSAA lessons, students develop resources contributing to the development of the five skills in the Ecole Centrale's teaching programme:
- development of strategies relying on a precise analysis (stakes, definition of objectives, context, risk management, assessment of their own strengths and weaknesses and those of their partners and opponents);
- decision-making in real-time or at a time-remove based on a refined perception of how the context will evolve;
- contribution to the development of a group or a team which functions effectively, taking into consideration and respecting the skills of each of the members;
- capacity to act independently with a view to developing their own skill level.

Assessments
Continuous assessment
Students are assessed on their assiduity, their level of commitment to progress, and their investment for optimal functioning of the group.

Bibliography
None indicated

Skills through internships

Guillaume Graton
Head of theme at École centrale de Marseille

ECTS credits	Code for the TU
5	ING_1A_S5_BETA_CEA
5	ING_1A_S5_ALPHA_CEA
2	ING_1A_S6_BETA_CEA
2	ING_1A_S5_ALPHA_CEA

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total
					4	**4**

Language
French

Teaching team
The teaching team is composed of ECM tutors. The latter attend the oral presentations and help the interns if any problems arise.

Objectives

The "Skills through internships" module aims to train interns to complete a specific mission in a company, laboratory, start-up or non-profit context. Interns are supervised during their internship periods by a "career tutor" (company, laboratory, start-up, non-profit) and a "school tutor". The objective is to become familiar with a specific setting, adopt the codes of conduct, understand how the structure functions, and develop innovative solutions to move the project forward.

Programme

After finding an internship in a company, laboratory, start-up or as part of a non-profit project, the intern must do their utmost to understand and become familiar with their workplace environment, delimit their mission and role, and clearly identify key contacts. They must also have regular contact with their "school tutor", to keep them informed of the mission and its progression. The module ends with two assessments: a school assessment based on an oral presentation, and a "career tutor" assessment.
The important points are the following:
• training (basic knowledge, aptitude for learning, analytical capacity, capacity to summarise, creativity and level of innovation);
• work and results (based on quality, quantity, efficacy, achievement of objectives, meeting deadlines, grasp of the subject, mastery of the subject);
• personality (initiative, sociability, contacts established, interests, motivation, sense of responsibility, method and organisation, communication, open-mindedness, judgement calls and realism).

Skills

The oral presentation in semester 5 will provide:

→ An introduction to the company or laboratory;

→ Expectations related to the subject;

→ The student's personal approach. Why an internship? Motivation?
The oral presentation in semester 6 will involve:

→ A more detailed presentation of the mission: what is it? How is it integrated?

→ Understanding of the mission;

→ How the work has gone so far and how it will proceed (perspectives);

→ Analysis of the project: what is the context? What are the challenges, the objectives, the interested parties?

→ How far should the project be developed?

Assessments

The module includes an oral presentation by a group of five or six interns and an assessment by the "career tutor".
The two assessments are awarded a lettered grade (A: Excellent, B: Very good, C: Good, D: Quite good, E: Pass, F: Fail).
The final grade is an average of the grades from the two assessments; when the mean is difficult to determine (e.g. A and B), the assessment by the "career tutor" takes precedence.

Bibliography

As this teaching unit is very specific to each intern, there is no and cannot be any general bibliography.

Projets

Guillaume Graton
Head of theme at École centrale de Marseille

Objectives
Programme
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Assessments
Bibliography

ECTS credits
4 ou 5

Code for the TU
ING_1A_S5_BETA_PA
ING_1A_S5_BETA_PT
ING_1A_S6_BETA_PA
ING_1A_S6_BETA_PT
ING_1A_S5_ALPHA_PA
ING_1A_S5_ALPHA_PT
ING_1A_S6_ALPHA_PA
ING_1A_S6_ALPHA_PT

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total

Language
French

Teaching team

Internship S5/S6

Head of theme at École centrale de Marseille

Objectives

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Skills

Assessments

Bibliography

ECTS credits
3

Code for the TU
ING_1A_S5_BETA_STAG
ING_1A_S6_BETA_STAG

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total

Language
French

Teaching team

Training

Guillaume Graton
Head of theme at École centrale de Marseille

Objectives

Programme

Skills

Assessments

Bibliography

ECTS credits	Code for the TU
4	ING_1A_S5_BETA_TA
7	ING_1A_S5_BETA_TING
4	ING_1A_S6_BETA_TA
4	ING_1A_S6_BETA_TING
6	ING_1A_S5_ALPHA_TING
3	ING_1A_S5_ALPHA_TA
3	ING_1A_S6_ALPHA_TING
3	ING_1A_S6_ALPHA_TA

Total volume of (student) hours for the TU

L	T	PW	IW	Projets	Other	Total

Language
French

Teaching team