CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2025-2026

YEAR 2

CIVIL ENGINEERING

MATERIALS AND STRUCTURES IN THEIR ENVIRONMENT - GRADUATE PROGRAM

PROGRAMME SUPERVISOR(S):
Giulio SCIARRA

YEAR 2 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
CPM	Coupled problems in mechanics: from mathematical formulation to numerical methods	6
PORME	Mechanics of Porous Media	5
SURR	Surrogate modeling	2
TOME3	Tools & Methods for Research 3	5

ELECTIVE COURSES

Course code	Title	ECTS Credits
DESIG	Design and Behaviour of Modern Concrete	5
DURAB	Durability and Structural Maintenance	5
EARTH	Earthquake Engineering	5
HOMMS	Homogenization methods for materials and structures	5
STATI	Statistics of Materials and Structural Reliability	5

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE3	Cultural and Communication English	2
ESP3	Spanish Language	2
FLE3	French Language	2

YEAR 2 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
THESIS	Master Thesis or Industrial Internship	30

Coupled problems in mechanics: from mathematical formulation to numerical methods [CPM]

LEAD PROFESSOR(S): Laurent STAINIER

Requirements

Continuum Mechanics, Numerical Methods in Engineering, Finite Element Method

Objectives

The course will present and discuss variational approches to coupled problems, such as thermo-mechanics or poro-elasticity. Variational approaches consist in formulating the problem as an optimization problem (on unknown fields), and constitute a fundamental basis in numerical approximation methods, such as finite elements. The course will also present and discuss various computational approaches for the numerical simulation of coupled problems, first from an abstract point of view of coupled systems. These concepts will then be put into practice for specific types of coupled problems, such as thermo-mechanics or poro-mechanics. Consequences of different potential choices in formulation and algorithms will be explored and discussed, with an emphasis on notions of physical and numerical stability.

Course contents

The course will be organized as follows:
- review of variational formulations in solid mechanics and heat transfer,
- time-continuous variational formulations for coupled problems,
- time-discrete (incremental) variational formulations for coupled problems,
- examples in thermo-mechanics and poro-mechanics,
- the various classes of coupled problems (weak vs. strong coupling),
- the various classes of algorithmic approaches (monolithic, staggered, sequential),
- the problems and difficulties linked to field transfer.

Course material

L. Stainier, A Variational Approach to Modeling Coupled Thermo-Mechanical Nonlinear Dissipative Behaviors, Advances in Applied Mechanics 46:69-126 (2013).
D.E. Keyes et al., Multiphysics simulations: Challenges and opportunities, International Journal of High Performance Computing Applications 27: 4 (2013).

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

Coupled problems are ubiquitous in engineering problems, specially in energy production systems. Numerical simulations in this field thus allows to design better and more efficient engineering systems. These tools are also useful in geophysical studies.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	6	33 hrs	12 hrs	0 hrs	0 hrs	2 hrs

Mechanics of Porous Media [PORME]

LEAD PROFESSOR(S): Giulio SCIARRA

Requirements

Continuum mechanics, Constitutive laws

Objectives

The lectures cover the characterization of constitutive laws of porous media addressing both the response of soils (in saturated and partially saturated conditions) and concrete.
Thermodynamics is used to identify admissible constitutive laws so as to establish the framework of thermo-hydro-mechanical analysis of (partially) saturated porous media.
Element of proroplasticity are provided.

Course contents

Introduction to the mechanics of porous media
Thermodynamics & fluid transfer
Thermal effects
Partially saturated porous media
Poroelasticity
Thermo-hydro-mechanical constitutive laws
(Poro-)plastic constitutive laws for soils
(Poro-)plasticity

Course material

- O. Coussy Poromechanics 2004 Wiley
- O. Coussy Mechanics and Physics of Porous Solids 2010 Wiley
- L. Dormieux, E. Bourgeois Introduction à la micromécanique des milieux poreux 2002 Presses Ecole National des Ponts et Chaussées
- L. Dormieux, D. Kondo, F.J. Ulm Microporomechanics 2006 Wiley

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The course provides competences in the characterization and modeling of geomaterials (as soils and rocks) and concrete,

which are of paramount importance in the sustainable management of energy resources (e.g. the underground storage of CO2 or of hydrocarbons/hydrogen synthesized from renewable energies or geothermal energy exploitation), in the thermal improvement of building materials (for reducing energy bills and greenhouse gas emissions) or in the protection against natural hazards (e.g. coastal erosion, landslides, floodings). Examples will be provided to coarsely describe some of the environmental issues that can be tackled by the acquired knowledge.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

Surrogate modeling [SURR]

LEAD PROFESSOR(S): Giulio SCIARRA / Mathilde CHEVREUIL

Requirements

Nothing

Objectives

This course is an introduction to machine learning: the role of surrogate modeling in engineering design optimization, inverse problems or uncertainty quantification is presented and the basic concepts for its construction based on observations are introduced.

At the end of the course the students will be able to:
- classify supervised or unsupervised learning methods,
- describe and select model classes,
- construct a model approximation based on observed data,
- validate the approximation,
- use the model approximation as a surrogate model (also known as metamodel).

Course contents

The lectures will cover the following:

- Design of experiment
- Classical parametrized model classes: neural networks, polynomial chaos, gaussian process, support vector machine, reduced order models
- Learning methods
- Validation metrics and techniques for error estimation

Tutorial and homework sessions will allow the students to practice and construct metamodels on benchmarks or data bases.

Course material

- The elements of Statistical learning, H. Friedman, R. Tibshirani and T. Hastie, Springer, 2009
- Model Reduction and Approximation: Theory and Algorithms, P. Benner, A. Cohen, M. Ohlberger and K Willcox, SIAM, 2017
- Neural networks and deep leaning, M. A. Nielson, 2015

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

Machine learning and design optimization is becoming more and more important for the success of Green Building projects in civil engineering, as these projects often involve unique challenges linked to sustainability goals and the use of innovative technologies. Competences aquired via this course will allow to develop new approaches to address both project success and long-term sustainability goals.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	16 hrs	16 hrs	0 hrs	0 hrs	0 hrs

Tools & Methods for Research 3 [TOME3]

LEAD PROFESSOR(S): Giulio SCIARRA

Objectives

This is second deeper step into laboratory research activities in view of testing the attitude of students to applied research and scientific development.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

This is an individual follow-up of the first laboratory research project developped during the first year of the master. Students will improve competences in research activities in the domain of durability of materials and structures, that could be propedeutic for the preparation of the Master Thesis, as for instance: structures lifetime extension and vulnerability reduction, building material optimization and waste reduction through reuse and recycling, sustainable management of renewable energy resources.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	0 hrs	0 hrs	0 hrs	30 hrs	0 hrs

Design and Behaviour of Modern Concrete [DESIG]

LEAD PROFESSOR(S): Ahmed LOUKILI

Objectives

The aim of the course is to provide knowledge of the physical, chemical and mechanical properties of materials used in the composition of concrete and teach standard practices for its formulation for a better mechanical behavior.

Skill: mix design of concrete in order to have the best mechanical and durability behaviors.

Course contents

- Cement hydration in the presence of mineral additives.
- Cement hydration.
- Physical consequences of cement hydration.
- Microstructure of the cement paste.
- Deferred concrete behavior: shrinkage and creep.
- Theoretical basis for the formulation of concrete.
- Basics of formulation of modern concretes and for a reliable environmental impact.
- Fracture mechanics of concrete
- Advanced experimental methods

Course material

A. Neville " Properties of concrete" Ed. Eyrolles

Sustainable Development Goals (SDGs) covered by this course

Responsible consumption and production / Sustainable cities and communities

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

Durability and Structural Maintenance [DURAB]

LEAD PROFESSOR(S): Abdelhafid KHELIDJ / Giulio SCIARRA

Objectives

The objective of the course is the identification and the use of sustainability indicators, as permeability and diffusivity, within the framework of sophisticated models of coupled transfers of chemical species. A performance approach to sustainability of structures is discussed based on the formulation of concrete for an expected lifespan in a given environment. Non-destructive testing skills are also provided to monitor life of structures and calibrate the models to evaluate their durability.

Course contents

Part 1 – Durability

- Reminders: Presentation of concrete - Hydration reactions and various compounds
- General approach to concrete durability: Corrosion -Sulphate attack - Alkali aggregate reaction - Frost
- Permeability: Darcy Law - Poiseuille law - How to measure permeability - Klinkenberg effect - Forsheimer law - Effect of damage - Effect of crack - Effect of temperature - Effect of saturation
- Chloride Diffusion: Fick's laws (1st and second) - Bind and free chloride - How to measure chloride diffusion? (Steady state / Unsteady state) - Migration and Nernst-Planck law - Effect of temperature - Effect of crack
- Carbonation: When and where? - The condition for carbonation in concrete - How to measure the depth of carbonation?

Part 2 - Experimental aspects and Macroscopic modelling of chloride transfer in cementitious materials

- Mechanisms involved during chloride ingress (chloride binding, electrostatic interaction, Electrical Double Layer (EDL), activity of pore solution
- Approaches to modelling chloride transfer in saturated concrete: Mono specie Approach (Modified Fick's Law) - Multi species Approach based on Nernst-Planck equation - Multi species approach with consideration of EDL Approaches of modelling of chloride transfer in saturated concrete
- Initiation to chloride transfer in unsaturated concrete

Part 3 - Structural maintenance

- Context on NDT: Specificity of NDT, Employment situations and requirements - Implementation of NDT versus management cases - French associations promoting NDT quality
- Generality on NDT: Non-Destructive Testing aims – Vocabulary - Inverse problem
- Basics of ultrasonic methods: Basics of wave propagation (elastic homogeneous linear isotropic) - Geometry characterization - Material properties characterization
- Classical US techniques (transmission, refraction, ultrasonic pulse echo, impact echo): principle and experimental set-up - signal processing - example of results
- Advanced US methods (tomography, surface wave, coda wave): principle and experimental set-up - signal processing - example of results
- Ground Penetrating Radar technique: Physical Principle - Data processing - Civil engineering applications
- Electromagnetic NDT techniques: Low frequency technique - Infra-red technique -Gammagraphy

Part 4 - Performance-based specifications

- Context of durability and why performance-based specifications are needed: Examples - Delayed ettringite formation -

Shrinkage-induced cracking
- Deemed-to-satisfy provisions: Standards - Minimum cover - Exposure classes
- Performance-based approach of durability: Carbonation – Chlorides – Leaching - External sulphate attacks

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

Concrete is the most consumed and used material in the world. It is considered in the absence of precautions as a material polluting the atmosphere because of the large amount of CO2 emitted during the calcination of clay and limestone. Concrete structures must therefore be not just well dimensioned to achieve the envisaged bearing capacity, but they must be durable too. Studying the durability of concrete structures is therefore the good way to limit CO2 emissions and dispersion of other harmful products for the environment.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

Earthquake Engineering [EARTH]

LEAD PROFESSOR(S): Panagiotis KOTRONIS

Requirements

Reinforced concrete, mechanics of structures, continuum mechanics, numerical analysis

Objectives

Dynamic behavior of structures, soil dynamics, nonlinear calculations and design of earthquake-resistant structures.

Course contents

Part I - Dynamics of structures

- Seismic risk, seismic hazard
- Dynamic equation of a simple oscillator, solving the equation
- Dynamic equation of a multi-degree-of-freedom structure, solving the equation
- Modal analysis, modal superposition technique, modal spectrum analysis
- Earthquake-resistant structure design according to EC8, capacity design
- Nonlinear calculations
- Introduction to nuclear plant design

Part 2 - Soil dynamics and geotechnical earthquake engineering

- Dynamic soil properties
- Ground motion parameters
- Wave propagation
- Ground response analysis
- Soil liquefaction
- Seismic slope stability
- Seismic design of foundations

Acquired skill: Calculating a structure submitted to earthquake loading.

Course material

Dynamique des structures - Application aux ouvrages de génie civil, Patrick Paultre, Hermès, Lavoisier, 2004.
Génie parasismique. Volumes I-II-III, Betbeder-Matibet , J., Hermes sciences publ., Lavoisier, 2003.
Dynamics of Structures, Theory and Applications to Earthquake Engineering, Anil K. Chopra, second edition, Prentice-Hall, 2001.
M. Géradin and D. Rixen. Mechanical vibrations. John Wiley and Sons, 1997.
Pratique du calcul sismique guide d'application de l'Eurocode. Sous la direction de V. Davidovici. Eyrolles, Afnor éditions, 2013.
Geotechnical Earthquake Engineering, Steven L Kramer

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The design of buildings is not limited to seismic resistance alone but also incorporates a sustainable development and corporate social responsibility approach, aiming to create resilient structures while ensuring the safety of populations and the longevity of infrastructure for future generations.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

Homogenization methods for materials and structures [HOMMS]

LEAD PROFESSOR(S): Giulio SCIARRA

Requirements

Numerical Analysis, Numerical Methods

Objectives

The course deals with the characterisation of the behavior of heterogeneous materials and slender structures by means of upscaling methods. Upscaling
techniques allow to estimate equivalent constitutive properties of a continuum describing the deformation of a body using an average coarse formulation which stems from the knowledge of
the characteristics of a more refined one. Examples are ubiquitous in materials & structures of civil engineering, as for instance granular materials, beam, shell and masonry structures, but also
metamaterials, where the micro-structure designed to achieve a specific goal is homogenized into average macro-scale constitutive parameters.
The competences achieved will be of paramount importance in the comprehension of response of aggregate materials according to their specific composition and the design of control strategies
of structures of civil engineering in response to complex loadings.

Course contents

Microstructural descriptors: n-Point Probability Functions, ensemble averages, ergodic hypothesis and statistical homogeneity, scale separation, notion of the Representative Volume Element (RVE).
Averaging operations, concentration and homogenization: uniform stress (strain) boundary conditions. Hill Lemma. Reuss and Voigt bounds.
Classical homogenization schemes for elastic and poroelastic materials.
Asymptotic expansion method for linear homogeneous elastic structures: beams and plates.
Justification of the Euler-Navier-Bernoulli and Love-Kirchhoff models.
Double-scale expansion and periodic homogenization. Applications to the study of incompressible Newtonian fluid flow through a rigid porous medium (the Darcy law) and quasi-statics of saturated
deformable porous media.
Homogenization of periodic heterogeneous beams.
Practical projects: (i) numerical homogenization of heterogeneous materials, (ii) numerical
solution of the homogenization problem for a periodic beam using Abaqus.

Course material

- J.L. Auriault et al. Homogenization of Coupled Phenomena in Heterogeneous Media. (2009) Wiley
- P.G. Ciarlet. Mathematical Elasticity - Volume II : Theory of Plates. Studies in mathematics and its applications. – North-Holland, Amsterdam, 1997
- L. Dormieux, D. Kondo, F.J. Ulm Microporomechanics. (2006) Wiley
- T. Kanit et al. Determination of the size of the representative volume element for random composites: statistical and numerical approach. Int. J. Solids Structures 40 (2003) 3647- 3679
- T. Lewinski, J.J. Telega. Plates, laminates and shells: asymptotic analysis and homogenization, Vol. 52. World Scientific, 2000.
- S. Torquato Random Heterogeneous Materials (2002) Springer
- L. Trabucho, J.M. Viano. Mathematical Modelling of Rods. Handbook of Numerical Analysis, ed. par P.G. Ciarlet et J.L. Lions. pp. 487–974. North-Holland, Amsterdam, 1996.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

The competences achieved will be of paramount importance in the comprehension of the response of aggregate materials according to their specific composition and the design of control strategies of infrastructures of civil engineering in response to complex loadings.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	26 hrs	12 hrs	0 hrs	0 hrs	2 hrs

Statistics of Materials and Structural Reliability [STATI]

LEAD PROFESSOR(S): Franck SCHOEFS / Giulio SCIARRA

Objectives

Accounting for uncertainties in civil engineering: risk and reliability.

Course contents

Part 1 - Introduction to probability and reliability in physical space.

▪ Introduction to random variables and stochastic fields.
Second order variables and iso-probabilistic transformations - Example of typical laws - Random fields properties: stationarity and ergodicity - Typical autocorrelation function and calculation technique - Maximum likelihood: identification of the parameters characterizing probability distributions and autocorrelation functions
▪ Probability of failure and reliability index of Rjanytzine-Cornell, the Hasofer-Lind extension.
Statement of a reliability problem starting from the concept of limit state: safety margin, limit state function - Evaluation of the probability of failure in the analytic case - Evaluation of the probability of failure in reference conditions and relation to the Rjanytzine-Cornell reliability index - Proof of the non-general character for a non-linear limit state function - Reliability of Hasofer-Lind

Part 2 - Evaluation of the reliability index in the physical space

▪ Method of the ellipsoid
▪ Approximate methods to estimate the probability of failure and errors: Monte-Carlo/ Importance Sampling/RSM

Part 3 - Practical cases with Matlab

▪ Numerical implementation and simulation of stochastic fields

Part 4 - Reliability index in the standard space

▪ Independent variables
▪ Correlated variables

Part 5 -Process of random degradation and reliability

▪ Introduction
▪ Basics of reinforced concrete:
▪ Overview of deterioration of reinforced concrete and corresponding legal issues
▪ Chloride-induced corrosion: mechanisms, models and parameters
▪ Corrosion propagation and cracking: mechanisms, models and parameters
▪ Fatigue of reinforced concrete: mechanisms, models and parameters
▪ Coupled mechanisms

Part 6 – Optimization

▪ Formulation of an optimization problem

Cost function - Optimization parameters - Optimization constraints - Example of optimization problems
▪ Fundamental optimization concepts
Global and local minima - Taylor polynomial expansion - Gradient Vector and Hessian matrix - Optimality conditions
▪ Linear optimization problems
Formulation of the linear programming problem - Simplex algorithm in linear programming
▪ Unconstrained nonlinear optimization
Study of the optimality condition on some functions - Mechanical Examples of unconstrained minimization
▪ Constrained nonlinear optimization problems
Equality constraints: Lagrange multipliers - Inequality constraints

Part 7 - Limit Analysis

▪ (Handout) Continuum mechanics: stress vector, stress tensor, Boundary conditions, stress eigen value and vectors, Bidimensional stress state, Mohr plane and Mohr circles, Normal stress and tangential stress, Local equilibrium equation
▪ (Handout) General concepts of plasticity: Notions of elastic limit, Partition to reversible and irreversible strains, bounding surface, Isotropic flow criteria, Anisotropic flow criteria, failure criterion, Loading and unloading criterion, Plastic flow law, Plastic potential, Work hardening modulus and plastic multiplier.
▪ Bars plasticity: Local equilibrium equation, Generalized behavior laws of beams, Failure state of beams
▪ Fundamental theorems in plasticity
Internal and external variables - Internal and external generalized variables - Principle of virtual work - Theorem of maximal plastic work of Hill - Static approach: Lower bound theorem - Kinematic approach: Upper bound theorem

Course material

No references

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

Effective risk management is essential for the success of Green Building projects in civil engineering, as these projects often involve unique challenges linked to sustainability goals and the use of innovative technologies. Competences aquired via this course will allow to design risk management approaches to address both project success and long-term sustainability goals.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

Cultural and Communication English [CCE3]

LEAD PROFESSOR(S): David TROYA

Objectives

- Understand the fundamental principles of scientific writing and the importance of clarity and precision in communication.
- Structure scientific documents effectively, adhering to genre-specific conventions.
- Employ appropriate language and tone for diverse scientific audiences.
- Integrate and cite sources correctly to support research arguments and findings.
- Edit and revise their writing for coherence, style, and grammatical accuracy.
- Prepare and deliver scientific presentations, both written and oral.

Course contents

Introduction to Scientific Writing

Overview:

This course provides an essential foundation in scientific writing, equipping students with the skills necessary to effectively communicate research findings and scientific concepts. Through a combination of lectures, workshops, and practical assignments, students will learn the conventions of scientific writing, including structure, style, and clarity. The course will cover various types of scientific documents, such as research papers, literature reviews, grant proposals, and poster presentations.

Course Structure:

The course will be organized into weekly sessions that include lectures on theoretical concepts, hands-on writing exercises, peer review workshops, and discussions of exemplary scientific literature. Students will engage in collaborative projects and receive constructive feedback to enhance their writing skills.

Assessment:

Students will be assessed through a combination of assignments, including written documents, peer review participation, and presentations. Active participation in workshops and discussions is also required to foster a collaborative learning environment.

Course material

Hoogenboom BJ, Manske RC. How to write a scientific article. Int J Sports Phys Ther. 2012 Oct;7(5):512-7. PMID: 23091783; PMCID: PMC3474301.

Paré G, Kitsiou S. Chapter 9Methods for Literature Reviews. In: Lau F, Kuziemsky C, editors. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]. Victoria (BC): University of Victoria; 2017 Feb 27. Available from: https://www.ncbi.nlm.nih.gov/books/NBK481583/

How to Create a Research Poster. A guide fo creating a research poster. https://guides.nyu.edu/posters

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Quality education

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Spanish Language [ESP3]

LEAD PROFESSOR(S): Marta HERRERA

Requirements

N/A

Objectives

For beginners:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of vocabulary and linguistic structures
Be able to talk about yourself and those around you
Be able to express oneself during daily activities
Know how to give your opinion

For advanced students:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of specialised vocabulary
Be able to understand the essential content of concrete or abstract subjects including a technical discussion
Be able to communicate spontaneously and fluently
Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:
Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)
Present tense (regular and irregular)
Language patterns to express habit, obligation, "gustar" and its equivalents,
Possessive adjectives
Differences between "es", "está", "hay"
Use of "por" and "para"
Adverbs and frequency patterns
Numeral adjectives

For advanced students:
Knowledge of the Hispanic world (economic, technical, cultural and social environment)
Present tense (regular and irregular)
Imperative
Past tenses
Direct / indirect style
Future tense
Conditional tense
Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Climate action / Decent work and economic growth / Gender equality / Goo health and well-being / Industry, innovation and infrastructure / No poverty / Partnership s for the goals / Peace, justice and strong institutions / Quality education / Reduced inequalities / Responsible consumption and production / Sustainable cities and communities / Zero hunger

Sustainable Development and Social Responsibility Positioning

Key competencies for sustainability Collaboration: the abilities to learn, to understand and respect others; to deal with conflicts in a group; and to facilitate collaborative and participatory problem solving. Critical thinking: the ability to reflect on one's own values, perceptions and actions. Self-awareness: the ability to reflect on one's own role in a group; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Spanish	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

French Language [FLE3]

LEAD PROFESSOR(S): Silvia ERTL

Requirements

N/A

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:
- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources. Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture.

At the end of the course, complete beginners can achieve an A1
level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels. Those who already completed the first year of the French course will be prepared for working in a French business environment.

Course contents

Two different tracks are proposed: track 1 for students newly arrived at Centrale Nantes and track 2 for students who have completed the first year of the French course. Track 1:
Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.
Learners will be able to use the foreign language in a simple way for the following purposes:

1. Giving and obtaining factual information:
- personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:
- meeting people and making acquaintances
- extending invitations and reacting to being invited
- proposing/arranging a course of action
- exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:
- making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- making purchases
- ordering food and drink

Track 2:
This track follows on directly from the first-year French course, developing and completing the concepts studied thus far. The main themes are: housing, health and work. These topics will help prepare students for their future work environment. For example, housing is explored in the form of a search for accommodation upon arrival in a new city. Special workshops for CVs and cover letters, elevator pitches and job interviews.

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Sustainable Development Goals (SDGs) covered by this course

Quality education

Sustainable Development and Social Responsibility Positioning

Targeted competencies extracted from: Education for sustainable development goals, learning objectives (UNESCO) https: //unesdoc.unesco.org/ark:/48223/pf0000247507 https://www.coe.int/fr/web/common-european-framework-reference-languages/official-translations-of-the-cefr-global-scale

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Master Thesis or Industrial Internship [THESIS]

LEAD PROFESSOR(S): Giulio SCIARRA

Objectives

The thesis/internship is evaluated through the submission of a written report and an oral defense.

Course contents

- Be exposed to and adapt to an industrial or research environment
- Put in practice the scientific and technical skills acquired in the previous semesters
- Strengthen interpersonal and communication skills
- Be part of or manage a project
- Organize tasks, analyze results and build deliverables

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Sustainable cities and communities

Sustainable Development and Social Responsibility Positioning

During the Master thesis, students are required to deal with research and development subjects in the domain of civil engineering mainly concerning structure lifetime extension and vulnerability reduction, building material optimization and waste reduction through reuse and recycling, sustainable management of renewable energy resources. The envelop of these topics constitutes the entry point to sustainability in environmental and civil engineering.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	30	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs