CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2024-2025

YEAR 2

CITY AND URBAN ENVIRONMENTS

ATMOSPHERE, WATER AND ENVIRONMENT

PROGRAMME SUPERVISOR(S):

Isabelle CALMET

YEAR 2 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
CLIMEN	Urban Climate and Energy	5
CSU	Case studies in the urban environment	4
METABL	Meteorology and Atmospheric Boundary Layers	4
POLLU	Urban Pollution	5
TURB	Turbulence : Theory, Modeling and Analysis	5
WAM	Urban Water Management and Modelling	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 Internship	30

Urban Climate and Energy [CLIMEN]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

M1 - Fluid mechanics
M1 - Energetics and Building heat transfers
M2 - Meteorology and Atmospheric Boundary Layer
M2 - Turbulence

Objectives

The aim of this course is to provide students with knowledge about the urban climate from city to neighbourhood scales, adaption and mitigation strategies to climate change and link between urban climate and energy demand. At the end of the course the students will be able to:

- Understand the urban climate issues
- Master the relationship between the energy fluxes exchanged between urban canopy and atmosphere, urban morphology and land-use, and urban climate
- Understand how urban planning can act on climate adaptation and mitigation
- Calculate the different energy flux exchanged at the surface of a complex urban surface (canyon street or surface covered with vegetation)
- Assess building energy demand at district scale

Course contents

This lecture aims to present:

- The urban heat island: cause and link with the energy budget of the urban canopy
- Climate modelling at city scale: urban surface energy budget (SEB) models coupled with atmospheric model
- The characteristics of a SEB model which will be used to compute energy fluxes between canopy and atmosphere and assess mitigation strategies at city scale
- The different ways to assess indoor and outdoor thermal comfort
- Climate modelling from the district to the building's environment scale
- The different local climate adaptation strategies and their impact on building energy demand
- The calculation of building energy demand at district to city scale

Course material

- Oke, T., Mills, G., Christen A., & Voogt, J. (2017). Urban Climates. Cambridge: Cambridge University Press
- Oke, T. R. (1987). Boundary Layer Climates (second edition). London/New York: Routledge

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	18 hrs	12 hrs	0 hrs	2 hrs	0 hrs

Case studies in the urban environment [CSU]

LEAD PROFESSOR(S): Boris CONAN

Requirements

Objectives

The objective of this course is to put into practice the skills and knowledge acquired in the different courses of the training around an applied subject. Two topics are proposed to cover the whole training. Students are expected to:
- Be active team members in the projects,
- Manage their time according to the deadlines given for the progress (and final) reports,
- Write reports presenting their work,
- Investigate a new topic in a framework which differs from academic training,
- Improve their knowledge through practice and their ability to analyze the subject.

Course contents

Work will be done in pairs during the scheduled courses and outside of class time. Regular reports will be presented as well as a final restitution.

Course material

All courses

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	4 hrs	4 hrs	6 hrs	18 hrs	0 hrs

Meteorology and Atmospheric Boundary Layers [METABL]

LEAD PROFESSOR(S): Boris CONAN

Requirements

Objectives

The aim of this course is to provide students with the theoretical basics on meteorology and atmospheric boundary layer physics. At the end of the course the students will be able to:
- Understand general mechanisms of meteorology
- Master the overall organization of the atmosphere
- Make and analyse a Skew-T plot
- Analyse meteorological data
- Determine the atmospheric stratification
- Understand the influence of the surface energy budget on the atmospheric turbulence and diurnal and vertical evolution of the meteorological variables within the atmospheric boundary layer
- Master the Monin-Obukhov similarity theory for the atmospheric surface layer
- Calculate wind and temperature profiles in the surface layer based on in situ measurements

Course contents

This lecture aims to present the:
- Global mechanisms involved in meteorology and phenomenology
- Thermodynamic transformations of air in the atmosphere
- General equations of meteorology
- Simplified equations of the atmospheric boundary layer and surface layer flows
- Theoretical knowledge about the dynamics of the atmospheric boundary layer
- Surface energy budget and the link with stratification conditions
- Monin-Obukhov similarity theory and applications

Course material

- Stull, R., 2017: "Practical Meteorology: An Algebra-based Survey of Atmospheric Science" -version 1.02b. Univ. of British Columbia. 940 pages. Isbn 978-0-88865-283-6.
- https://www.eoas.ubc.ca/books/Practical_Meteorology/
- Stull, B., 1988, An introduction to boundary layer meteorology, Kluwer Academic Press, Dordrecht/Boston/London

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	12 hrs	0 hrs	0 hrs	2 hrs

Urban Pollution [POLLU]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

M1 - Fluid mechanics
M1 - Hydrology and transfers in soils
M2 - Meteorology and Atmospheric Boundary Layer
M2 - Turbulence

Objectives

The aim of this course is to provide students with knowledge about urban air and soil pollution. This course is divided in three complementary parts addressing the chemistry of urban air pollution, the pollutant dispersion in the atmosphere and the urban soil quality issues.

At the end the first part, it is expected the students be able to:
▪ Master the fundamentals of atmospheric chemistry (chemical kinetics, mechanisms of air pollutant formation)
▪ Understand how different atmospheric regimes lead to distinct relationships between air pollutant levels and urban emissions
▪ Develop the expertise needed to design efficient emission control strategy for gaseous pollutants and atmospheric particles thanks to a comprehensive knowledge of the formation of urban air pollution
▪ Apply that knowledge to real-world situations.

At the end of the second part, the students will be able to:
▪ Understand the link between the dynamics of the atmosphere and the pollutant dispersion
▪ Apply simple dispersion models and understand their limitations (in terms of scale and application)

At the end of the third part, the students will be able to:
▪ Describe the main properties of urban soils depending on the land-use
▪ Explain what are the ecosystem functions and services of urban soils

Course contents

Part 1 - Chemistry of urban air pollution
▪ Main sources of air pollutants
▪ Formation of gaseous urban air pollutants (ozone, nitrogen dioxide,...)
▪ Dynamics and formation of atmospheric particles.
The approach will consist of lectures on the conceptual and theoretical aspects of air pollution chemistry and applications to actual case studies. The two case studies used in class are a summer ozone episode and a spring particulate matter episode in the Paris region. The aim is to develop emission control strategies to reduce air pollutant levels for those two episodes using the knowledge acquired during the lectures.

Part 2 - Pollutant dispersion in the atmosphere
▪ Factors that govern or influence the dispersion process (meteorology, turbulence, stratification, buildings, orography...)
▪ Gaussian models (semi-empirical plume and puff models): Theory and application for estimating the pollutant concentration in simple configurations;
▪ Presentation of usual numerical approaches (CFD-based) for pollutant dispersion simulation.

Part 3 – Pollution of urban soils
▪ Specificities of urban soils

▪ Ecosystem functions and services of urban soils.
Some examples of land-use and associated soil quality will be presented and a visit of an urban allotment garden is foreseen to illustrate the topic.

Course material

Seigneur C., Air pollution : Concepts, Theory and Applications, Cambridge University press, 2019.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	19 hrs	11 hrs	0 hrs	0 hrs	2 hrs

Turbulence : Theory, Modeling and Analysis [TURB]

LEAD PROFESSOR(S): Laurent PERRET

Requirements

Objectives

The aim of this course is to provide students with theoretical basics on turbulent flows and modelling approaches in CFD codes. At the end of the course the students will be able to:

- Grasp turbulent flow physics
- Use various statistics to characterize turbulent flows
- Derive equations for averaged variables
- Understand the concepts of various modelling approaches of turbulent flows (RANS, LES)
- Master the requirements associated with modelling approaches in terms of CFD: computational domains, grid size, boundary conditions, etc
- Design, perform and analyse CFD simulations for incompressible turbulent flow in simple configurations using RANS modelling

Course contents

This course aims to present:

- An introduction to turbulent flows and their physics
- The basic concepts and tools used to study turbulent flows
- The scales of turbulent flows and the energy cascade
- The equations for the averaged variables (Reynolds Averaged Navier-Stokes (RANS) equations)
- The near wall behaviour of turbulent flows
- Some closure models for Reynolds Averaged Navier-Stokes (RANS) equations
- The concept of Large Eddy Simulation (LES) and subgrid-scale modelling
- The main requirements and best choices to design a numerical simulation of turbulent flow according to the modelling approach

Course material

- Davidson, P. A. (2015), Turbulence: An Introduction for Scientists and Engineers, Oxford University Press.
- Pope, S. B. (2000), Turbulent Flows, Cambridge University Press.
- Wyngaard, J. C. (2010), Turbulence in the Atmosphere, Cambridge University Press.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	8 hrs	6 hrs	0 hrs	2 hrs

Urban Water Management and Modelling [WAM]

LEAD PROFESSOR(S): Fabrice RODRIGUEZ / Isabelle CALMET

Requirements

Hydrology and transfers in soils

Objectives

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

- Grasp the basics of both traditional storm and waste-water systems and Sustainable Urban Drainage Systems (SUDS)
- Design sewer pipes
- Use a simple urban hydrological model
- Analyse the main trends of a rainfall-runoff data series applied to an urban catchment
- Grasp the quality of storm water and waste water
- Describe the composition of sediments from SUDS and evaluate pollution levels
- Assess the environmental risk associated with pollutant content and propose sediment management techniques

Course contents

This course aims to present:

- Sewer systems in the city: description and design
- Sustainable urban drainage systems: principles and scientific and user feedback
- Storm water urban hydrological modelling
- Waste water: quality and treatment basics
- Storm water: quality and pollution level measurements
- Characteristics and quality of sediments from SUDS
- Risk evaluation
- Sediment management

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	19 hrs	11 hrs	0 hrs	0 hrs	2 hrs

Cultural and Communication English [CCE3]

LEAD PROFESSOR(S): David TROYA

Requirements

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

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

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).

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 Internship [THESIS]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

All or part of the master's courses

Objectives

- 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

Course contents

Students should be pro-active and career-oriented in the search for their thesis/internship. The topics are validated by the program supervisor to ensure an adequate Master level. The thesis/internship is evaluated through the submission of a written report and an oral defense.

Course material

- Turabian Kate Larimore, Booth Wayne Clayton, Colomb Gregory G., Williams Joseph M., & University of Chicago press. (2013). A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers (8th edition.). Chicago (Ill.) London: University of Chicago Press.
- Bui Yvonne N. How to Write a Master's Thesis. 2nd ed. Thousand Oaks, Calif: Sage, 2014.
- Evans David G., Gruba Paul, et Zobel Justin. How to Write a Better Thesis. 3rd edition. Carlton South, Vic: Melbourne University Press, 2011.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Ce syllabus n'a aucune valeur contractuelle. Son contenu est susceptible d'évoluer d'une année à l'autre.
This syllabus is not a legally binding document. Content is subject to change year on year.