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CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

CITY AND URBAN ENVIRONMENTS

ATMOSPHERE, WATER AND ENVIRONMENT

YEAR 2

PROGRAMME SUPERVISOR:
ISABELLE CALMET

Établissement public sous tutelle du ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation

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CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT

YEAR 2 - AUTUMN SEMESTER

Urban Water Management and Modelling

Project

Urban Climate and Energy

Urban Pollution

Meteo and Atmospheric Boundary Layers

Turbulence : Theory, Modeling and Analysis

Cultural and Communication English

French Language

URBAN WATER MANAGEMENT AND MODELLING

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Fabrice RODRIGUEZ

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

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	5	19 hrs	10 hrs	3 hrs	0 hrs	2 hrs

PROJECT

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Isabelle CALMET

Objectives

The aim of the project is for students to discover, by themselves, a topic related to urban environment and to explore it in depth, based on a bibliographic study and skills learned during the master. Throughout the project, it is expected that students:

- Be active team members in the project
- Manage their time according to the deadlines given for the progress (and final) reports
- Make the link between the project topic and the knowledge provided during the master programme
- Write reports presenting their work
- Investigate a new topic in a framework which differs from academic training

Course contents

Various topics will be proposed by the teachers at the beginning of the semester. The work will be performed in pairs outside of class hours. It is broken down into two parts: a bibliographic study and application using knowledge acquired during the master. Regular reports will be presented to the teacher who proposed the project topic: Two progress reports (the week before Autumn holidays, the week before Christmas holiday) and the final report (by the end of the semester).

Course material

All the course material.

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	4	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

URBAN CLIMATE AND ENERGY

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Isabelle CALMET

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

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

URBAN POLLUTION

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Isabelle CALMET

Objectives

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

At the end of the first part, it is expected that 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 strategies 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 pollutant dispersion
- Apply simple dispersion models and understand their limitations (in terms of scale and application)
- Simulate and analyse pollutant dispersion in complex urban areas

At the end of the third part, the students will be able to:

- Describe the main properties of urban soils depending on land-use
- Explain the functions and ecosystem services of urban soils

Course contents

Following a brief summary of the main sources of air pollutants, the first part of the course will address the chemistry of urban air pollution in two parts: (1) the formation of gaseous urban air pollutants, such as ozone and nitrogen dioxide, and (2) the dynamics and formation of atmospheric particles. For each part, the approach will consist in lectures on the conceptual and theoretical aspects of air pollution chemistry and applications to actual case studies. Some of the tools commonly available to simulate urban air pollution will be described. The two case studies used in class are a summer ozone episode and a spring particulate matter episode in the Paris region. The students will be asked to develop emission control strategies to reduce air pollutant levels for those two episodes using the knowledge acquired during the lectures.

The second part of the course will address pollutant dispersion in the atmosphere by presenting: the factors that govern or influence the dispersion process (meteorology, turbulence, stratification, buildings, orography etc); the theory, limitation and use of semi-empirical Gaussian or plume models. Other numerical methods based on Computational Fluid Dynamics will be

introduced and lab sessions will be organized in order to study the dispersion in urban areas (FluiDyn software will be used for these sessions).

Finally, the last part of the course aims to present the specificities of urban soils and the functions and ecosystem 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 planned to illustrate the topic.

Course material

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	5	19 hrs	15 hrs	0 hrs	0 hrs	2 hrs

METEO AND ATMOSPHERIC BOUNDARY LAYERS

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Boris CONAN

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 organisation 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

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

TURBULENCE : THEORY, MODELING AND ANALYSIS

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Laurent PERRET

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.

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	4	16 hrs	8 hrs	6 hrs	0 hrs	2 hrs

CULTURAL AND COMMUNICATION ENGLISH

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Spencer HAWKRIDGE

Objectives

Team-building and Communicational English:

- Understand the general concepts of team-building
- Build a team-building project
- Understand and nurture the creative process
- Enhance self-belief and self-empowerment

Behavioral skills in an inter-cultural environment:

- Strengthen self-confidence and capacity for interaction
- Develop active listening and reformulation skills
- Develop networking skills

Course contents

Cultural and Communicational English: exercises to explore in practice the areas of culture and communication
Field-related or inter-cultural project (for example, construct content for inter-cultural teambuilding activities; example WIOBOX website etc).

Course material

Written and televised press, information and digital tools, general documents business environment and company strategies.
Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
English	4	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

FRENCH LANGUAGE

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - AUTUMN SEMESTER

LEAD PROFESSOR: Silvia ERTL

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 (2 semesters), 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.

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).

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LABO	PROJECT	EXAM
French	**4**	**0 hrs**	**32 hrs**	**0 hrs**	**0 hrs**	**0 hrs**

YEAR 2 - SPRING SEMESTER

Master Thesis / Internship

MASTER THESIS / INTERNSHIP

CITY AND URBAN ENVIRONMENTS - ATMOSPHERE, WATER AND ENVIRONMENT
YEAR 2 - SPRING SEMESTER

LEAD PROFESSOR: Isabelle CALMET

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.

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