
ENGINEERING PROGRAMME

2024-2025

Year 2 / Year 3

Specialisation option

Engineering Science for Housing
and Urban Environment

OD PHYCITE

PROGRAMME SUPERVISOR

Isabelle CALMET



Autumn Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 73	12	Core course	CONSTR EVT PRURB SINBAD	Building engineering Ecology, city and territories Urban issues Geographic information systems and databases
UE 74	13	Core course	ACECE ENERGUR HATUR IBIM P1PHYCITE	Acoustics, light and solar radiation Applied thermodynamics for urban engineering Urban hydrology and atmosphere BIM initiation Project 1

Spring Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 83	2	Core course	P2PHYCITE	project 2
		Track: Housing	CTAIR MATHA TECBA THBATP	Air treatment and conditioning Materials for building comfort Building technology Thermal performance of buildings
		Track: Urban engineering	ATRAN ENEVI GENUI HATUA	Urban planning and transportation Energy at the city scale Management of noise and polluted soils Applied urban hydrology and atmosphere

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Building engineering [CONSTR]

LEAD PROFESSOR(S): Patrice CARTRAUD

Requirements

Objectives

This course is devoted to structural and soil mechanics, and foundations. The basics of these domains are taught under the form of lectures and tutorials focusing on very practical considerations.

Course contents

- The stakeholders and structure professions within construction.
- Eurocode standards
- Structural mechanics : beams
- Basics of reinforced concrete beams
- Basics of soil mechanics : characterisation, stresses, soil hydraulic, shear strength

Course material

- Précis de Structures de Génie Civil, Projets, Dimensionnements, Normalisation D. Didier et al., Afnor, Nathan
- Les Eurocodes : Conception des bâtiments et des ouvrages de Génie Civil
Sous la Direction de Moreau de Saint-Martin et Jean-Armand Calgaro
Edition le Moniteur, ISBN 2-281-12560-8
- Mécanique des Structures, Étude des Poutres, P. Cartraud, 2011, <https://cel.archives-ouvertes.fr/cel-00451733/fr/>
- Introduction au béton armé: théorie et applications courantes selon l'Eurocode 2., Granju, J. L. 2014, Éditions Eyrolles.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Ecology, city and territories [EVT]

LEAD PROFESSOR(S): *Géraldine MOLINA / Isabelle CALMET*

Requirements

Energy, Environment and Climate Challenges - ENCLI

Objectives

In a context of heightened environmental concerns, this course aims to provide a skillset for engineers to tackle the major contemporary issues of manufacturing, urban and regional management in order to implement ecological transition solutions. Inspired by the "engineering of nature" (Gilles Clément), the aim is to promote engineering training based on systemic environmental and social intelligence. The challenge is to train professionals capable of developing a multi-criteria approach to environmental issues in order to devise sustainable solutions that meet the challenges of ecological preservation and restoration, and the health and well-being of regional populations.

Course contents

Lectures and tutorials will be conducted in class or during site visits to address the following four main cross-disciplinary topics:

1. Towards the sustainable city: urban planning models (manufacturing, management, lifestyles):
 - . general contextual elements: socio-history of the relationship between the city and the environment: evolution of urban planning models in relation to environmental, social, technical, economic developments; emergence of the question of the sustainable city and urban ecological transition.
 - . issues linked to economic crisis, change and transitions
 - . visit focused on the move towards the sustainable city and contemporary issues
2. The different stakeholders: occupations, organisations, urban ecological transition policies, etc.
 - . description of institutional, political and planning transition in cities
 - . city, energy and environment professionals: analysis of feedback from professionals, analysis of technical solution trajectories
3. Techniques for thinking about the transition:
 - . field surveys and data: taking into account a context to develop solutions adapted to the environment and the populations concerned
 - . socio-technical approaches: a range of scientific techniques from social sciences applied to engineering
 - . alternative technical systems: presentation of concrete examples and field visits
4. Social transitions: changes in lifestyles
 - . Inhabitants and lifestyles: recent developments in various areas (consumption, energy, transport, waste, mobility, etc.)
 - . People and lifestyles: exposure, vulnerability and adaptation strategies for climate change.

Course material

- . Hébert Florent, 2015, Villes en transition : l'expérience partagée des Écocités, Marseille, Parenthèse.
- . Courgey Samuel, Oliva Jean-Pierre, 2006, La conception bioclimatique. Des maisons confortables et économes. En neuf et en réhabilitation, terre vivante.
- . Molina Géraldine, Musy Marjorie, Lefranc Margot, 2017, Les professionnels du bâtiment face aux défis énergétiques et environnementaux : compétences et pratiques en transition, Londres, ISTE Editions.
- . Mathieu RIVAT, 2017, Ces maires qui changent tout. Le génie créatif des communes, Actes Sud.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	12 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Urban issues [PRURB]

LEAD PROFESSOR(S): *Isabelle CALMET*

Requirements

Objectives

The organic metaphor, which compares the city to a living being, and the mechanistic metaphor, which sees it as a multiform, multi-scale system of flows and exchanges, both demonstrate the fascination that the phenomenon of urbanisation holds for mankind, and sum up its great complexity. As an introduction to the following modules, this course aims to grasp some of the keys to this complexity and attempt to explain what makes the city today. It will highlight the issues of adaptation and reaction to physical and climatic phenomena in the urban environment.

Course contents

The course is divided in two parts, which are dealt with simultaneously in the form of lectures and tutorials. A historical approach, known as the 'history of the city', is designed to describe and analyse the different ways in which cities are created and formed. The second part deals with the main challenges of contemporary urban development.

The historical approach attempts to summarise the major trends in architectural and urban theories since the Second World War. We will begin by examining the ambivalence of Reconstruction, between culturalism and functionalism, and how the logic of zoning, the concept of large housing and the disappearance of the street were established as public policies, particularly in France. Faced with the techno-solutionism invoked in response to unprecedented demographic growth, other solutions emerged around the 1970s, renewing a relationship with history as well as with vernacular practices. The aim of this chronological survey is to stimulate back-and-forth exchanges and comparisons between the debates of the past and situations observed today.

The second part develops the major sub-topics of contemporary urban issues: the main definitions of urban vocabulary; the concepts of sustainable cities, resilient cities and sober cities; tools to support the implementation of urban practices at different spatial scales with examples of implementation at various scales (neighbourhoods, cities and metropolises); urban infrastructures and their roles; the role of urban engineering and its evolution. Thematic tutorials are also provided to cover topics such as: the production and analysis of performance indicators; urban sprawl and density; mobility, transport and accessibility; the sensitive city.

Course material

Panerai, Philippe. 1999. Analyse urbaine. Paris: Parenthèse
 Jean-Marc Stébé et Hervé Marchal (sous la dir. de). 2009. Traité sur la ville. Paris: Presses universitaires de France
 Levy, Albert (sous la direction de). 2012. Ville, urbanisme et santé. Editions Pascal. Mutualité Française
 Vincent Fouchier et Pierre Merlin. 1994. Les fortes densités urbaines: une solution pour nos villes? Hong Kong.
 Sabine Barles. 2005. L'invention des déchets urbains. Seyssel: Champ Vallon.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	12 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 73 / 93

Geographic information systems and databases [SINBAD]

LEAD PROFESSOR(S): Jean-Yves MARTIN

Requirements

Objectives

To introduce the main elements for understanding databases, especially spatial databases which are used in Geographic Information Systems (GIS).

Course contents

This course is divided into 2 parts: theoretical and practical work.

The theoretical aspects include:

- Introduction to functional analysis
- The relational model theory
- From functional analysis to physical models
- Introduction to SQL
- Programming with databases
- Introduction to PL/SQL
- GIS and spatial databases
- Introduction to XML. Main data formats
- Introduction to Spatial Data Infrastructure
- Introduction to Big Data

Practical work includes

- Building, creating and using a database
- Using GIS

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	14 hrs	4 hrs	12 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Acoustics, light and solar radiation [ACECE]

LEAD PROFESSOR(S): *Isabelle CALMET*

Requirements

Physics and fluid dynamics - FLUID

Objectives

This course is organised in 3 parts dealing with acoustics, solar radiation and daylighting.

Part 1 - Acoustics

The objective of this course is to introduce the fundamental concepts of physical acoustics, to provide the basic knowledge required to successfully design the acoustics of a building, and finally to present the physiological mechanisms of hearing, the main elements of sound perception and the effects of noise on health.

Part 2 - Solar Radiation

This course deals with the nature of solar movements that define the potential of sunshine duration and the solar energy resources of a site or a built area. The first part will develop the consideration of the solar dimension throughout history. Theoretical knowledge of solar geometry will then facilitate the use of simple techniques for assessing and controlling the amount of sunlight in different parts of a building and urban space. To estimate solar contributions, a number of various techniques will be presented, from the construction of manual drawings to the use of solar diagrams and numerical tools. Practical sessions will consist of carrying out different types of analysis using numerical tools: determining sun paths and shadows, quantifying sunshine duration, identifying masks in the built environment and assessing energy contribution.

Part 3 - Daylighting

This course addresses the issues of daylighting in the fields of architecture and town planning. The objective is to understand the physical and radiative phenomena that are responsible for natural light, its transmission and diffusion. This leads to managing natural light strategies for architectural and urban projects, based on an analysis of building morphology and light control devices. These physical aspects will be completed by an analysis of visual comfort, which uses more subjective concepts mostly related to user behaviour. To estimate the photometric parameters related to the control of natural light, the course will present more or less complex design tools, from in situ measurement to predictive computing tools. Examples of analyses from the urban scale to that of architectural features will be presented. Practical sessions will lead students to carry out various analyses using models and numerical simulations: availability of natural light in urban spaces or daylight factor for indoor spaces, visibility of singular urban objects and quality of views, impact of a new building, etc.

Course contents

Part 1 - Acoustics

- Physical acoustics
 - Elements of acoustics
 - Basic equations and principles
- Room and building acoustics
 - Reverberation time
 - Other criteria related to the acoustic quality of rooms
 - Absorbent materials
 - Isolation / Attenuation
 - Tools for room and building acousticians
 - Practical solutions for implementation
- Psychoacoustics and noise effects
 - Physical description of noise

- Physiological dimension of noise
- Elements of psychoacoustics
- Auditory effects of noise
- Extra-auditory effects of noise

Part 2 - Solar Radiation

- History of the consideration of sunshine periods in the architectural and urban project
- Solar geometry
- Construction and use of solar diagrams
- Solar and energy simulation algorithms
- Numerical tools for simulating solar radiation and energy

Part 3 - Daylighting

- Direct and diffuse light
- Normalized skies and lighting simulation methods
- Light reflection: colour and texture of materials
- Photometry
- Perception and comfort, contrast, glare
- Daylight factor
- Numerical tools for simulating daylight and visibility

Course material

- Derek Phillips (2004), Daylighting, Natural Light in Architecture, Elsevier Eds.
- Mohamed Boubekri (2008), Daylighting, Architecture and Health, Elsevier Eds.
- Jennifer O'Connor (1997), Tips for Daylighting with Windows, LBNL-39945
- Edward Mazria (1981), Le guide de l'énergie solaire passive, Parentheses Eds.
- Garry Stevens (1990), The reasoning architect : Mathematics and Science in Design, McGraw-Hill Eds.
- Sophia Behling and Stefan Behling (2000), Solar Power: The Evolution of Sustainable Architecture, Prestel Pubs.

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Applied thermodynamics for urban engineering [ENERGUR]

LEAD PROFESSOR(S): Jean-François HETET

Requirements

Objectives

This course aims to bring skills and knowledges on energy issues with a particular focus on urban and housing applications

Course contents

First courses are focusing on thermal losses of a building calculation and then a complete energy balance of a building will be considered including heating by a heat pump and thermal solar captation.

Then labs are organized : heat pump, A/C system, thermal transfer and thermal solar energy

Finally, presentations by the students about energetic issues linked to urban environment are programmed : wood energy, smart grid, P2V, Power to gas, RME, regulations, energy storage, nuclear energy (SMR), geothermal energy, solar energy, wind energy, heat networks.

Course material

Thermodynamique et énergétique par M. BOREL (Presses polytechniques Romandes)

Thermodynamique générale et application par R. KLING (Technip)

Thermodynamique par J.P. PEREZ (Masson)

Energétique par M. FEIDT (Dunod)

Introduction aux problèmes énergétiques globaux par R. GICQUEL (Presses des Mines)

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	4 hrs	8 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Urban hydrology and atmosphere [HATUR]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Energy, Environment and Climate Challenges - ENCLI
Physics and fluid dynamics – FLUID

Objectives

To provide scientific concepts necessary to understand the atmospheric, hydrologic, geochemical and hydrodynamic processes, and their interactions with soil-surface-atmosphere interfaces influencing the microclimate and air, water and soil quality in natural or urban areas.

Course contents

Part 1 - Hydrology

- Water cycle: water and matter fluxes
- Hydrographical networks and water transfer processes (atmosphere-surface-soil)
- Composition of natural waters, biogeochemical cycles, components and soil reactivity
- Mass transfer processes in-soils
- Urban environment specificities: water cycle modifications, sewer networks, urban water, waste water, urban pollution

Part 2 - Atmosphere

- Urban atmosphere: issues and context
- Atmospheric boundary layer simplified equations
- Basic knowledge of turbulence, statistical tools and characteristic scales
- Dynamics of the atmospheric boundary layer: Diurnal cycle, atmospheric stability and turbulence
- Surface layer processes: energy balance and similarity theory
- Introduction to urban specificities and influence on the energy budget

Course material

- Stull, R., 1988, An introduction to boundary layer meteorology, Kluwer Academic Press, Dordrecht/Boston/London
- Laura Sigg, Werner Stumm, Philippe Behra (2014) Chimie des milieux aquatiques - Cours et exercices corrigés - Master, écoles d'ingénieurs - Collection Sciences sup

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

BIM initiation [IBIM]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Building engineering - CONSTR

Objectives

This course deals with the concept of Building Information Modelling (BIM), the actors of BIM, BIM implementation in a project and its application in architectural projects, in connection with building trades. The teaching is based in particular on the learning of 3D parametric modelling software (REVIT) that incorporates BIM concepts. Approached in a logic of production of architectural projects, the course will allow to apprehend the methods of modelling and structural and constructive design, and to fill in the project and the data in a perspective of management and exploitation of the building.

Course contents

- Concept of Building Information Modelling
- Collaboration methods and definition of a BIM process (BIM specifications, BIM agreements, roles definition)
- Basics in the use of a 3D parametric tool :
 - Modelling a project based on plan analyses
 - Production of representation views (plans, sections, elevations, axonometry)
- Presentation of a BIM project concept : visualization environment
- Architectural and structural design :
 - Management of the 3D database of parametric objects (metric, quantitative)
 - 3D organisation of the model: Files management, compliance with standards, consistency of the model, relevance of the construction method.
- Model geo-localisation, classification and generation of IFC files
- Analysis of an IFC file:
 - Generation of a clash report
 - Information exchanges (BCF files)
 - Data extraction

Course material

Guézo J. et Navarra P. (2018) Revit pour les architectes : Bonnes pratiques BIM, 516 pages, Editions Eyrolles

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	12 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Autumn Semester - Course Unit 74 / 94

Project 1 [P1PHYCITE]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Objectives

P1PHYCITE is the first part of an 80-hour project. The objective of the project is to explore a topic related to city or building engineering, and to use the knowledge and skills acquired in the specialization. During the project students work in groups of 2 to 3.

Course contents

- Choice of topics: October
- Group work and progress meetings: October to January
- Project progress defence (P1): end of January
- Group work and progress meetings: February to March
- Final report and project defence (P2): end of March

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	1	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

project 2 [P2PHYCITE]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Objectives

P2PHYCITE is the second part of an 80-hour project. The objective of the project is to explore a topic related to city or building engineering, and to use the knowledge and skills acquired in the specialization. During the project students work in groups of 2 to 3.

Course contents

- Choice of topics: October
- Group work and progress meetings: October to January
- Project progress defence (P1): end of January
- Group work and progress meetings: February to March
- Final report and project defence (P2): end of March

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	0 hrs	0 hrs	48 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Urban planning and transportation [ATRAN]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Energy, Environment and Climate Challenges - ENCLI
Applied thermodynamics for urban engineering – ENERGUR

Objectives

This course, in two parts, deals with waste management and recovery, and urban transport engineering.

Course contents

Waste management and recovery:

- Issues of waste management
- From waste reduction to recovery: current solutions
- Evolution of regulations
- Organization and management methods in a territory (example of Nantes Métropole)
- Recovery of waste for energy production

Transport Engineering

- Introduction: Actors, regulatory framework and planning
- Multimodal modelling: static displacement modelling
- Evaluation of projects and public policies
- Traffic engineering and dynamic modelling
- Smart transport
- Public transport and alternative modes (service offer and uses)
- Road sharing - urban design

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	30 hrs	0 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Energy at the city scale [ENEVI]

LEAD PROFESSOR(S): Auline RODLER / Isabelle CALMET

Requirements

Energy, Environment and Climate Challenges - ENCLI
Applied thermodynamics for urban engineering – ENERGUR

Objectives

Cities account for a high proportion of energy use and therefore energy consumption. Most constructions and renovations are carried out in urban areas, within a context of densification, and we know that it is necessary to take this environment into account both in the design of buildings and the evaluation of proposed technical solutions. Furthermore, most urban projects concern an entire urban block or district, which are suitable for specific energy strategies: networking, sharing... Finally, in a context of global warming in which urban heat island phenomena (UHI) are more intense, the design of energy and climate within a district should be carried out simultaneously. Indeed, it has been proved that some technical solutions such as external thermal insulation enhance UHI phenomena and that some outdoor cooling solution could rise the buildings' energy needs. The course aims to:

- show the issues associated with thermal design of a building or group of buildings in urban areas
- understand the principles of the tools that can be used to address energy management from building scale to that of a building stock (statistical approaches, simplified thermal simulation)
- address large-scale energy diagnostic field methods (typological approaches, infrared remote sensing)
- address heating networks, but also smart grids.

At the conclusion of the course students should know the range of tools necessary to evaluate the energy impact of urban density (gains and losses related to the compactness of the urban frame on the envelopes' efficiency and potential use of natural resources) which can then be balanced against the gains linked to the use of energy for transportation.

Course contents

- Physical phenomena on building and district scale
- Impact of building on its environment and retroaction
- Urban energy models
- Large-scale energy diagnosis
- Urban energy networks

Course material

Beckers, B. (Ed.), Solar Energy at Urban Scale, ISTE, 2013, 384 p.

Robinson, D., Computer Modelling for Sustainable Urban Design: Physical Principles, Methods and Applications, Routledge, 2011, 320p.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	12 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Management of noise and polluted soils [GENUI]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Acoustics, light and solar radiation - ACECE

Objectives

This course is divided into two distinct parts dealing, on the one hand, with noise and, on the other hand, with polluted soils in urban areas. It provides the legislative, methodological and technical background for identifying these nuisances and providing solutions in terms of reduction and remediation.

Course contents

Part 1: Noise in urban areas

- Impact of urban mobility on sound environments and noise reduction
 - The problem of noise pollution in cities
 - General aspects of urban noise environments
 - Indicators of environmental acoustics
 - Characterisation of urban noise environments: models and measurements
 - Solutions for noise reduction in cities by acting on mobility
 - Modelling approaches based on multiphysical couplings
 - Elements of prospective on urban noise environments
- Urban acoustics and soundscape
 - Soundscape
 - Urban Acoustics
 - Means to reduce urban noise
 - Perception of sound environments (research and field)
 - Representations of sound environments
- Sources of noise in urban areas
 - Review of noise, units and indicators in environmental acoustics
 - Characteristics of urban noise sources (key figures, regulatory aspects, emission properties of road traffic noise)
 - Tyre/road contact noise (physical phenomena, methods of measuring road noise, modelling road noise, influence of road surface)
- Environmental acoustics
 - Experimental demonstration of physical phenomena
 - Theoretical approach to ground effects on sound propagation
 - Theoretical approach to atmospheric effects on sound propagation
 - Numerical modelling
 - Uncertainties

Part 2 : Management of polluted sites and soils in urban areas

- Context and issues related to polluted sites and soils in urban areas
- National methodology for the management of polluted sites and soils:
 - inventories of (potentially) polluted sites;
 - management of polluted soils from diagnosis to management methods, including remediation techniques.
- Practical application via a case study of the various concepts addressed in the course

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Applied urban hydrology and atmosphere [HATUA]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Urban hydrology and atmosphere - HATUR

Objectives

To provide the knowledge required to develop mitigation strategies for water flows and treatment techniques of urban water and soil. Provide the knowledge necessary to study and develop mitigation strategies of urban microclimate and air quality in view of adapting the city to changes (climate, densification).

Course contents

Part 1 - Hydrology

- Instrumentation and measurement in quantitative and qualitative hydrology (in situ, under laboratory conditions)
- Data treatment methodologies and tools (geostatistics, abacus, standards)
- Water uses and regulation on water quality
- Soil functions and soil artificialisation
- Treatment techniques and numerical models:
 - Sewer devices and SUDs (sustainable urban devices)
 - Processes of water treatment in WWTP (waste water treatment plant)
 - Pollutant transfer models
 - Hydrological models

Part 2 : Atmosphere

- Scales and approaches for the study of urban atmosphere.
- Flow and pollutant dispersion at the street-scale.
- Urban heat island
- Methods and models to represent interactions between the city and the lower atmosphere, and application (influence of urban planning scenarios on the energy budget).
- Basic models for the study of pollutant dispersion at the city scale.
- Wind tunnel studies for urban planning assessment.

Course material

- Oke, Mills, Christen and Voogt (2017) Urban Climates, Cambridge university press
- <https://www.inrae.fr/actualites/sols-artificialises-processus-dartificialisation-sols>

Assessment

Collective assessment: EVC 1 (coefficient 0.5)

Individual assessment: EVI 1 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Air treatment and conditioning [CTAIR]

LEAD PROFESSOR(S): David CHALET

Requirements

Objectives

The objective of this course is to study the different technical solutions to heat and cool the air of a building as well as solutions for obtaining domestic hot water.

Course contents

The first part of the course starts with a presentation of the different systems which can be used for heating and domestic hot water production as well as the role of each element. A complete presentation of the different conventional heat generators (classification of boilers, water heater, looping hot water and regulations) as well as generators using renewable energy (geothermal, aerothermal, aquathermal, solar, wood, etc.) will be provided. Subsequently, our attention will turn to water distribution (composition of the various circuits, materials, hydraulic balancing, regulations etc.). This part will conclude with implementation of practical examples and probably with a company visit.

The second part of the course focuses on air conditioning. First, an overview will be provided (control of temperature and humidity, etc). Then, a load calculation is carried out in order to define the different air treatment operations. All technical solutions will be covered followed by a real case study.

Course material

Assessment

Collective assessment: EVC 1 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.8)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Materials for building comfort [MATHA]

LEAD PROFESSOR(S): Alain MAIBOOM

Requirements

Objectives

The design of the envelope of a building requires a good knowledge of the behavior of the materials involved, in particular the insulation materials. This course describes the physical properties of insulation materials to control the transfer of humidity, heat and noise. The different insulation techniques for the implementation of insulators are described; their environmental impact is also addressed through life cycle assessment.

Course contents

- Humidity transfer through the walls of a building:
 - Humid air and water vapour permeability of materials
 - Rules of implementation
 - Examples of walls
- Material properties for thermal insulation:
 - Heat transfers through the walls
 - Insulation: presentation of the different insulation materials and application techniques
- Acoustic insulation :
 - Acoustic physics in construction, regulations and labels.
 - Construction systems: diversity of materials and assembly methods that influence their acoustic properties.
 - Building comfort or how to reconcile acoustics, thermal insulation and ventilation.
- Life cycle assessment of materials:
 - Principle of LCA
 - Calculation rules and INIES data base
 - French environmental regulation RE2020
- Bio-sourced materials :
 - Properties of bio-sourced materials and their use in buildings

Course material

- Transferts d'humidité à travers les parois, Guide technique CSTB
- Cours de thermique du bâtiment (THBATP)

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	10 hrs	0 hrs	0 hrs	2 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Building technology [TECBA]

LEAD PROFESSOR(S): Isabelle CALMET

Requirements

Building engineering - CONSTR

Objectives

- To provide the fundamentals that guide overall design of the building structure from a mechanical point of view but also according to the technologies used both in terms of materials and constructive components;
- To present the basic concepts for the realisation of timber constructions;
- To address issues related to construction pathology and builder's liability and insurance;
- To present reinforcement and improvement techniques aimed at ensuring the stability of structures, according to the types of soil and structure;
- To present the geotechnical aspects and implementation techniques of underground works intended for the movement of people, vehicles and goods or fluids, in increasingly complex contexts linked to growing urbanisation, the increase in the density of the urban fabric and the value of space, the increasing scarcity of available space, the concern to reduce the nuisance to local residents during works and the sensitivity of the population to the environment.

Course contents

- Overall design of the building structure :
 - Load-bearing function of the structure
 - Stability of the structure
 - Ground foundation of the structure
- Timber as a building material :
 - Timber material
 - Solid Timber and Engineered Timber
 - Building systems
 - Design and dimensioning
- Building disease :
 - Condensation
 - Wood disease
 - Water ingress
 - Floor coverings
 - Removal and inflation of clay soils
 - Radon
- Liability and insurance of builders
- Soil improvement and reinforcement technics :
 - Introduction: complex soils, tests and instrumentation
 - Compaction techniques
 - Reinforcement techniques
 - Treatment techniques
- Introduction to underground works :
 - The general context of underground work
 - Geotechnical aspects of underground works
 - Construction techniques
 - "Traditional" methods with or without "land treatment"

- Mechanized methods: tunnel boring machines
- Geotechnical approach of a tunnel project
- The role of site monitoring and auscultations

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	20 hrs	12 hrs	0 hrs	0 hrs	0 hrs

ENGINEERING - OD PHYCITE

Year 2 / Year 3 - Spring Semester - Course Unit 103 / 83

Thermal performance of buildings [THBATP]

LEAD PROFESSOR(S): Alain MAIBOOM

Requirements

Objectives

This course provides fundamental practical knowledge for the design of building envelopes from a thermal perspective (new builds and thermal renovation of existing buildings).

Course contents

The course outlines the tools and calculation methods to approach the design of a building from a thermal perspective, using a steady-state method and a dynamic simulation method.

The first part of the course begins with an overview of the main ideas, some key figures, the energy context for the building sector and introduces the concept of thermal comfort. Then the course addresses the main calculation methods within the regulatory context (RE 2020), with steady-state assumption, heat loss through the envelope, how to insulate a building etc. Strategies to curb heat loss via thermal bridges and air exchange (double flow ventilation) are also covered.

In the second part training is provided on how to use Pleiades COMFIE software, which is used to perform dynamic thermal simulations of buildings, essential in the new regulatory environment. It can be particularly useful for the estimation of thermal comfort and energy efficiency in the winter and summer months.

Course material

- [1] Ministère de la transition écologique, Chiffres clés de l'énergie, Édition 2021.
- [2] ADEME, Climat, Air et Energie - Les chiffres clés, 2018.
- [3] J.-P. Oliva and S. Courgey, La conception bioclimatique: Des maisons économes et confortables en neuf et en réhabilitation. terre vivante, 2006.
- [4] ADEME, Le confort d'été - Guide de l'ADEME. 2007.
- [5] Ministère de la transition écologique et de la cohésion des territoires, Guide RE2020 - Eco-construire pour le confort de tous.
- [6] Guide pratique CSTB: Les ponts thermiques dans le bâtiment - mieux les connaître pour mieux les traiter
- [7] RE 2020 et rénovation énergétique - Guide pratique pour les bâtiments neufs et existants - Maisons et copropriétés - Sénova - Collection Eyrolles Environnement

Assessment

Collective assessment: EVC 1 (coefficient 0.3)

Individual assessment: EVI 1 (coefficient 0.7)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	22 hrs	8 hrs	0 hrs	0 hrs	2 hrs