

SHAKE THE FUTURE.



# ENGINEERING PROGRAMME

**SPECIALISATION**

**ENERGY PRODUCTION AND  
MANAGEMENT**  
SPRING SEMESTER

# THERMAL PERFORMANCE OF BUILDINGS

ENERGY PRODUCTION AND MANAGEMENT, ENGINEERING PROGRAMME SPECIALISATION  
SPRING SEMESTER

*Professor: Charline DEMATTEO*

## 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 (18hrs) 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 (RT 2012), 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 (12hrs) training is provided on how to use TRNSYS 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

Chiffres clés du bâtiment, Edition 2013, ADEME

La conception bioclimatique: des maisons confortables et économes en neuf et en réhabilitation, Samuel Courgey et Jean-Pierre Oliva, Edition Terre Vivante 2006

Guide pratique CSTB: Les ponts thermiques dans le bâtiment - mieux les connaître pour mieux les traiter

## Keywords

Thermal comfort in a building, heat losses, thermal bridge, RT 2012, heat losses through ventilation, dynamic thermal simulation, summer comfort

## Links with other programmes

Applied Thermodynamics, Heating and air conditioning systems, Solar captation

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO  | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French   | 3            | 27 hrs   | 3 hrs     | 0 hrs | 0 hrs   |

# PROJECT 2

ENERGY PRODUCTION AND MANAGEMENT, ENGINEERING PROGRAMME SPECIALISATION  
SPRING SEMESTER

*Professor: Alain MAIBOOM*

## Objectives

To be involved in a collaborative project (2/3 students) on energy engineering.

## Course contents

Examples of previous projects:

- Design, manufacturing and experimentation of an air solar collector
- Study of inter-seasonal heat storage
- Study of a concentrated solar collector
- Study of a CHP system with combined cycles

## Course material

## Keywords

project, experiments, calculation, predimensioning

## Links with other programmes

All the courses of the specialisation.

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO  | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French   | 2            | 0 hrs    | 0 hrs     | 0 hrs | 48 hrs  |

# HEATING AND AIR-CONDITIONING SYSTEMS

ENERGY PRODUCTION AND MANAGEMENT, ENGINEERING PROGRAMME SPECIALISATION  
SPRING SEMESTER

*Professor: David CHALET*

## 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

In the first part of the course, an introduction will present the different systems which can be used for heating and domestic hot water production, but also to present the objectives of each element. A complete presentation of the different conventional heat generators will be carried out (classification of boilers, water heater, looping hot water and regulation) without forgetting the generators using renewable energy (geothermal, aerothermal, aquathermal, wood, etc). The possible couplings between the different systems (heating and DHW), traditional or renewable, will be presented. Subsequently, the water distribution will be studied (composition of the various circuits, materials, hydraulic balancing, regulation ...). This part will conclude with an implementation of practical examples and a company visit.

The second part of the course covers air conditioning. First, an overview will be performed (control of the 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 studied. A real case will be studied.

## Course material

## Keywords

Heat systems, Cooling systems, Domestic Hot Water

## Links with other programmes

Applied Thermodynamics, Thermal performance of buildings, Solar captation

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO  | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French   | 3            | 24 hrs   | 6 hrs     | 0 hrs | 0 hrs   |

# SOLAR CAPTATION

ENERGY PRODUCTION AND MANAGEMENT, ENGINEERING PROGRAMME SPECIALISATION  
SPRING SEMESTER

*Professor: Alain MAIBOOM*

## Objectives

This course presents the various techniques for solar energy collection.

## Course contents

The various techniques for solar energy collection and conversion are presented:

- Introduction on solar energy (4hrs): direct, scattered, reflected radiation, etc
- Active solar collection (4hrs): thermal solar panels (water and air): technologies and sizing
- Photo-voltaic panels (14hrs): technologies, cost and sizing
- Passive solar collection in buildings (4hrs): bioclimatic design: technologies and sizing
- Summer thermal comfort in buildings (4hrs).

## Course material

## Keywords

photo-voltaic energy, passive solar collection, solar thermal technologies (water and air)

## Links with other programmes

Applied thermodynamics, Low carbon energies, Thermal performance of buildings, Heating and air-conditioning systems

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO  | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French   | 3            | 24 hrs   | 2 hrs     | 0 hrs | 4 hrs   |

# CARBON BALANCE AND ENERGY AUDITING

ENERGY PRODUCTION AND MANAGEMENT, ENGINEERING PROGRAMME SPECIALISATION  
SPRING SEMESTER

*Professor: Thierry JASZAY*

## Objectives

This course presents two tools that are necessary for engineers who want to integrate environmental aspects in the design of a product, a system, or a method: the carbon balance and energy auditing.

## Course contents

### Part 1: Carbon Balance

The carbon balance of a product or a human entity is a tool to account for greenhouse gas emissions, which allows for effective solutions to be proposed to reduce conventional energy consumption and to study the vulnerability of an economic activity or a community with regards to fossil fuel dependency.

### Part 2: Energy Audit

The energy audit has become compulsory for large companies. The objective is to identify potential for energy savings and to set up an energy efficiency policy. The impact of the circular economy on the reduction of primary energy consumption will be also covered.

## Course material

## Keywords

Energy audit, carbon balance, circular economy, environment

## Links with other programmes

| LANGUAGE | ECTS CREDITS | LECTURES | TUTORIALS | LABO  | PROJECT |
|----------|--------------|----------|-----------|-------|---------|
| French   | 3            | 22 hrs   | 2 hrs     | 0 hrs | 8 hrs   |