

FOURTH YEAR INSA TOULOUSE

Autumn semester				
Concrete structures 1	6 credits	68h	Air conditioning	5 credits 66h
Indoor building physics	4 credits	65h	Equipments Acoustics	4 credits 48h
Improve your management abilities	4 credits	45h	Building project	5 credits 74h
Quality Safety Environment, Sport	6 credits	86h	Construction environment 2	3 credits 36h
Geotechnics 2	4 credits	47h	Initiation to research	3 credits 45h
Advanced non linear and computational structural and solid mechanics	6 credits	51h	Communicating within organizations	6 credits 75h
			Improving autonomy and building a professional project	4 credits 39h
Concrete structures 1				
	6 credits	68h		
Indoor building physics				
	4 credits	65h		
Improve your management abilities				
	4 credits	45h		
Quality Safety Environment, Sport				
	6 credits	86h		
Building networks (hot and cold water networks, aeraulics)				
	5 credits	66h		
Building devices (thermodynamic devices, electricity)				
	5 credits	70h		
Spring semester				
Building project	5 credits	74h		
Construction environment 2	3 credits	36h		
Initiation to research	3 credits	45h		
Improving autonomy and building a professional project	4 credits	39h		
Communicating within organizations	6 credits	75h		
Steel & timber structures	4 credits	86h		
Prestressed concrete structure & bridges	5 credits	67h		

Concrete structures 1



ECTS
6 credits



Component
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE



Number of
hours
68h

Presentation

Description

- * Basic rules of structural design for concrete structures according to Eurocodes.
 - * Actions and combinations of actions on structures.
 - * Foundations: actions on foundations, pad footings, pile caps.
 - * Choice of materials according to mechanical and environmental performance criteria.
 - * Effects of horizontal actions on bracing walls.
 - * Design and verification of simple elements:
- Vertical load-carrying components: columns and walls.
 - Horizontal load-carrying components: continuous concrete beams, floors (continuous supported slabs).
 - Bracing wall with or without windows.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Prominent design parts (bearing frames, foundations, bracing systems), and calculation of reinforced concrete buildings, submitted to vertical or horizontal loads.

The student will be able to:

Identify actions on the structures and environmental conditions, understand and predict the mechanical behavior of a structure, argue its technological choices (type of components and carrying systems, strength class of materials), design the various structural elements of a common construction and possess the needed basis to go further into particular domains, enrich a numerical model.

Pre-requisites

Structural analysis and engineering

Reinforced Concrete and prestressed concrete

Useful info

Place

➤ Toulouse

Indoor building physics

 **ECTS**
4 credits

 **Component**
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE

 **Number of
hours**
65h

Presentation

Description

Programme (detailed contents):

- Thermal and acoustic Comfort;
- Sensitizing with RT2012, the practice of the thermal insulation, bioclimatic concepts and labels HQE, LEED, BREEM ;
- Aerolics: principles to design a network;
- Heating: heat production, distribution and emission;
- Air conditioning: moist air diagram, elementary evolutions, design the elements of a air handling unit.
- Acoustics: physical acoustics, sound insulation of buildings, acoustics of the rooms, lawful aspects.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- useful criteria to qualify comfort;

- basic knowledge for designing a system of heating, ventilating and air conditioning (HVAC);
- to be sensitized to energy saving in HVAC systems and to thermal code RT;
- basic knowledge to treat the sound insulation of buildings.

The student will be able to:

- To design a simple installation of heating and air conditioning;
- To analyze the operation of the elements of an air conditioning and heating installation;
- To calculate the sound insulation of a wall, the time of reverberation of a room and to propose a treatment;
- To calculate the direct and reverberated acoustic fields;
- To enrich a numerical model.

Expected skills :

- * design a basic HVAC installation
- * analyze the operation of the elements of a heating and air conditioning system ;

- * calculate the sound insulation of a wall , the reverberation time of a room and offer treatment

Pre-requisites

Heat transfer and Fluid Mechanics I & II

Useful info

Contacts

Education manager

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Place

➤ Toulouse

Improve your management abilities

 **ECTS**
4 credits

 **Component**
INSTITUT
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APPLIQUEES
TOULOUSE

 **Number of
hours**
45h

Presentation

Objectives

At the end of this module, the student will have understood and be able to explain :

- * The basic rules of business law
- * The objectives, principles and means of marketing
- * The principles and procedures of financial diagnosis and / or investment

The student will be able to :


Apply principles and rules of management and law in simple situations. Take into account the parameters of the management (customer needs, cost effectiveness and legal compliance).

Useful info

Contacts

Education manager

LUCIE LECLERT

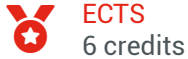
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Place

> Toulouse

Quality Safety Environment, Sport



ECTS
6 credits



Component
INSTITUT
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Number of
hours
86h

Presentation

Description

Acquire a culture of QSE and understand the principles of QSE management in the civil engineering construction.

- Risk prevention (E-Learning)
- Environmental Management
- Security Management
- Quality Management through LEAN Management

The conferences are given by civil engineers .

The "Risk Prevention" is an E-Learning module in partnership with OPPBTP

Implementation of a collective project, linked to the chosen physical and sports activities, through a deeper practice and knowledge of these PSAs.

Organization (process):

Part1: This teaching takes place in the form of conferences and independent projects to deepen certain key concepts (half a day / week).

Part 2: Physical and sporting activities (2h / week)

Useful info

Contacts

Education manager

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Place

➤ Toulouse

Geotechnics 2



ECTS
4 credits



Component
INSTITUT
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APPLIQUEES
TOULOUSE



Number of
hours
47h

Presentation

Description

Programme :

Geotechnical:

- 5 Active and passive soil pressure.
- 6 Verification of gravity and sheet pile walls.
- 7 Principal in situ testing.
- 8 Shallows foundations.
- 9 Deeps foundations.

Special geotechnical works

Objectives

Geotechnical design:

Design and verify foundations and earth retaining wall with Eurocode 7.

Determinate the active and passive soil pressure. Determinate forces of earth pressure.

Design a retaining wall.

Analyze famous in-situ testing.

Design shallows and deeps foundations.

Pre-requisites

Geotechnics 1

Useful info

Contacts

Education manager

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Place

➤ Toulouse

Advanced non linear and computational structural and solid mechanics

 **ECTS**
6 credits

 **Component**
INSTITUT
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TOULOUSE

 **Number of
hours**
51h

Presentation

Description

Programme (detailed contents):

Use limitations of first order analysis (linear analysis)

Non linear geometry

Local buckling: buckling, Lateral buckling, Lateral torsional buckling

Global buckling : Rayleigh-Timoshenko method

Non linear behaviour of materials

Yielding : constitutive laws and criteria, cross-section yielding, limit analysis of structures

Viscoelasticity: constitutive laws, stress relaxation and creep. Long term strain calculation using Laplace transform

Finite Element Method

Variational formulation, Principe of virtual power

Discretization

Assembly of system matrices and computation

Element properties

BEAM

PLATE-SHELL

SOLID

Stationary analysis, dynamic analysis (eigenvalue calculation), buckling

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

The use limitations of the linear mechanic

The different phenomena of buckling corresponding to different scales : cross-section, members, global structure

Analysis of structures with plastic hinges

Viscoelastic analysis, constitutive model of viscoelasticity, application to creep, stress relaxation and calculation of long-term strain

The structure modelling using Finite Element Method

Elements properties : BEAM, PLATE and SHELL, SOLID

The student will be able to:

Calculate the global buckling of structure

Calculate the local buckling of structural members

Calculate the ultimate load bearing capacity using plastic hinge method

Calculate a structure using Finite Element Software

Pre-requisites


Structural analysis and engineering

Useful info

Place

➤ Toulouse

Building networks (hot and cold water networks, aeraulics)

 **ECTS**
5 credits

 **Component**
INSTITUT
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DES SCIENCES
APPLIQUEES
TOULOUSE

 **Number of
hours**
66h

Presentation

To approach the lawful context (RT), aeraulic modeling (CFD, diffusion...), and to present demonstrative buildings.

Description

Program (detailed contents):

- * Hot water networks

In-depth presentation of the heating system (heat production, emission, distribution, operation)

Hydro-thermal performance of a heating system

- * Hydraulics

Based on the Technical Document 60-11: sizing of indoor hot and sanitary water devices, study of Legionella problem, sizing of storage systems, of pressure maintain devices. Sizing of sewage disposal.

- * Aeraulics

Increase public awareness of an the stakes of ventilation like to the movements of air out and in a building and to their "nonfatal" use in natural ventilation (VN). To learn how to choose and dimension an installation of ventilation (VN and VMC).

Organisation:

The technologies related to the heating systems are studied during regular classroom and a visit of a real heating network is planned.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

1. The hydro-thermal characteristics of a heating system
2. The pressure distribution in a network
3. The control strategies applied to heating systems used in buildings
4. How to design indoor hot and cold sanitary water devices (Building hydraulic)
5. How to design air devices: transport, supply (Building air devices)

The student will be able to:

- Design hydraulic and air networks by using the methods exposed during the seminars
- Analyse the behaviour of existing heating systems
- Design and size a heating system for collective housing

Pre-requisites

Heat transfer and Fluid Mechanics I & II

Useful info

Contacts

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Place

➤ Toulouse

Building devices (thermodynamic devices, electricity)

 ECTS
5 credits

 Component
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 Number of
hours
70h

Presentation

Description

Program:

- * Applied thermodynamic

Reminder of thermodynamic basics (1st and 2nd principles), study of the devices through their cycle: vapor turbine, thermal motors, cogeneration... Power and efficiency calculations

- * Electricity

Study of the C15-100 of the UTE C 15-105 guide. Analyze of various protections relating to the safety of electrical installations:

- protection of the circuits (choice of the protection apparatus adapted to a drain);
- protections of the people (modes of neutral, differential protection);

- * Metrology

Metrology fundamentals, basics of uncertainty calculation, calibration. Practical application to real HVAC systems.

Organization:

Thermodynamics and Electricity : Lecture, seminar

Metrology: lecture, tutorials, lab work.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The behavior and the design of classical thermodynamic devices used in buildings. (Applied thermodynamic)
- Protection and security techniques used in houses, collective housing or industrial buildings (Electricity)
- How to determine experimentally the energy balance of heating and cooling units (Metrology)

The student will be able to:

- Name and explain the protection and security techniques used in classical buildings
- Calculate thermodynamic devices efficiency (refrigeration, cogeneration...) and draw the corresponding cycles on thermodynamic charts
- Analyse experimental data and calculate the related uncertainty

Useful info

Contacts

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Place

➤ Toulouse

Building project



ECTS
5 credits



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Number of
hours
74h

Presentation

Description

The students apply what they have learned during the previous semester in structural design.

The project is divided in three parts:

1) Technical equipments

Acoustic and thermal insulation, choice and design of air conditioning and heating equipments. Installation plan.

2) Structural design

Foundations: actions on foundations, pad footings, pile caps.

Vertical load carrying components: columns, concrete walls, timber walls.

Horizontal load carrying components: continuous beams, concrete floors (continuous supported slabs), timber floors

3) Environmental impacts

Mass and energy management and their environmental impacts, both during the construction process and the use period of the project.

Organisation:

Session of presentation, technical installation part, structural design part with technical conferences interspersed, environmental approach. The numerical model of the project is then updated.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Main stages of design of a concrete building for the frame as well as for the air conditioning and heating systems.

The student will be able to:

Identify and calculate actions on structure, determine the energetic demands, understand the mechanical behavior of a frame as a whole, design and calculate the main structural members and heating or air conditioning circuits, use and enrich a numerical model.

Pre-requisites

Structural analysis and engineering

Concrete structures 1

Useful info

Contacts

Education manager

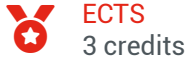
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Place

➤ Toulouse

Construction environment 2



Presentation

Notions sur la logistique de chantier dans le domaine de la construction (supply chain, LEAN).

Description

The components covered are:

- Prevention and Fire Safety for buildings,
- Accessibility for disabled persons in buildings,
- Indoor Air Quality,
- General Approach of Logistics and Construction (LEAN)
- Sustainable development

A project about Prevention and Fire Safety illustrates the lessons

Courses are mostly carried out by engineers from the professional world.

Objectives

Acquérir les approches réglementaires dans les domaines de l'Accessibilité et de la Sécurité Incendie dans les ERP. Sensibiliser aux problématiques de Qualité de l'Air Intérieur.

Useful info

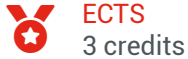
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Place

➤ Toulouse

Initiation to research



ECTS
3 credits



Component
INSTITUT
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TOULOUSE



Number of
hours
45h

Presentation

Description

Program (detailed contents):

- How to publish a scientific paper
- How to achieve a scientific littérature review
- Fundamentals of a given scientific field
- Modelling and / or testing
- Summarizing the research project by the mean of a scientific paper and a speech
- 3 subjects are proposed each year, the student have to pick one.

Organisation:

This teaching proceeds with a single research project which includes :

- A short presentation of scientific journals and Zotero

- A lecture used to introduce the research context and the main equations
- The research project, organized by groups of 4 students
- A speech

The scientific report will be written in English during the project. English courses are tailored to help the student with this.

Objectives

At the end of this course, the student will be able to explain :

- How the research results are disseminated / shared within the scientific community ;
- What are the main expectations of a scientific report ;
- The fundamentals of a specific scientific field (note that the topic is different every year).

The student will be able to :

- Search for a relevant scientific study in a database ;
- Use a numerical software to quote published scientific work.

- Summarize the main informations obtained during the research project by using the standards of a given scientific journal ;
- Make the information accessible to a lay audience.

Useful info

Contacts

Education manager

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Place

➤ Toulouse

Improving autonomy and building a professional project

 **ECTS**
4 credits

 **Component**
INSTITUT
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DES SCIENCES
APPLIQUEES
TOULOUSE

 **Number of
hours**
39h

Presentation

Place

➤ Toulouse

Objectives

Construire une équipe projet, Approfondir ses connaissances,


Investir le métier, les domaines d'activité, les fonctions.

L'étudiant devra être capable de :

- d'analyser avec les autres un problème posé (Identifier le problème, définir les axes d'approche dans un bilan interactif : organisation, physique, technique, stratégique, motivation, confiance...
- de décider ensemble (permettre à tout le monde d'exprimer son avis, ajuster et réguler sa conduite en fonction de l'analyse collective),
- d'identifier les ressources du groupe (sens critique, repérage des points forts et faibles de chacun).

Useful info

Communicating within organizations

 **ECTS**
6 credits **Component**
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE **Number of
hours**
75h

Presentation

<https://moodle.insa-toulouse.fr/course/view.php?id=44>

Objectives

The classes given in French will focus on :

- How to react to society's demand for technical and scientific information
- How to foster critical thinking in order to give appropriate answers when questioned about such issues
- How to communicate effectively in the workplace

The classes given in English will focus on the specific linguistic characteristics of English used in such contexts in order for the students to understand and master them.

The students will also be made aware of the specificity of professional communication within the English-speaking world

Module L2

The objectives, defined in reference to the CEFR for the 5 language activities, depend on the language studied - Chinese, German, Spanish - and the level of the student.

They can be consulted on :

In certain cases, students may be authorised to follow an English module instead of another language.

Pre-requisites

For classes in English : mastery of general English.

Useful info

Place

> Toulouse

Steel & timber structures



ECTS
4 credits



Component
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE



Number of
hours
86h

Presentation

Description

Programme (detailed contents):

- * Review of industrial branches timber and steel.
- * Properties of used materials (timber, wood products, steel).
- * Influence of environmental conditions on timber and wood products properties.
- * Classification and geometrical features of cross-sections.
- * Construction systems and frames (horizontal and vertical bearing members).
- * Structural behavior and effect of connections between members.
- * Actions and action combinations, principles of verification.
- * Consideration of structural imperfections.
- * Verification of resistance ultimate limit states of cross-sections.
- * Verification of stability ultimate limit states of members and shells.
- * Verification of serviceability limit states.
- * Principles and calculation of bracing systems and members.
- * Technology and calculation of main types of connection.
- * Verification of fire resistance.

Organisation:

Lectures, aided works, demonstrative lab works

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

The principles of design and calculation of steel structures and timber structures according to Eurocodes.

The student will be able to:

Analyse the structural behaviour of a timber or steel structure, justify the technological structural choices and materials, design the structural bearing and bracing members.

Pre-requisites

Analyse des structures statiques et dynamiques

Structures Béton Bois

Mécanique Avancée

Useful info

Place

➤ Toulouse

Prestressed concrete structure & bridges

 **ECTS**
5 credits **Component**
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE **Number of
hours**
67h

Presentation

Description

Programme (detailed contents):

Prestressed concrete structures

Design rules (EC2): minimum requirements towards cracking, stress limitation, minimum reinforcement and various layouts, calculation of the minimum prestress force, calculation of the prestress losses – Tensioning stages – Stress control – Calculation of the stresses in cracked cross-section under serviceability limit state – Calculation of the reinforcement areas.

Bridges

Terminology, bridge classification – Data for the project, design procedure – Technical regulation – Foundations: design and execution – Supports: piers and abutments – Superstructures: wearing surfaces, barrier walls, bearings, pavement joint, drainage, sidewalks – Concrete bridges: materials, field of use, pre-design, execution – Steel bridges: materials, field of use, joints, classification, pre-design, execution.

Organisation:

Lecture, tutorials project.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- * Technology, design and calculations of a prestressed concrete structure;
- * Technology and design of metallic, concrete or composite bridges.

The student will be able to:

- * State the required assumptions;
- * Calculate a prestressed concrete structure;

Define the technical choices for designing a bridge.

Pre-requisites

Reinforced Concrete and prestressed concrete

Structural analysis and engineering

Useful info

Place

➤ Toulouse

Air conditioning



ECTS
5 credits



Component
INSTITUT
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APPLIQUEES
TOULOUSE



Number of
hours
66h

Presentation

Description

This teaching provides additional elements on several parts of air conditioning (HVAC) topic :

- Calculation of thermal balances of rooms and buildings ;
- Principal air conditioning systems (HVAC) ;
- Air filtration ;
- Regulation of air conditioning installations.

Tutorials, labworks and project are realised during this formation. A visit on site is proposed.

Objectives

Main goal of this teaching is to allow student to learn conception elements and also best practices rules of air conditioning installations.

Expected skills :

* Analyze an air conditioning installation (HVAC) from the schematic drawing and determined specifications;

* Design main elements of an HVAC installation;

Identify and prioritize main elements of the control system from an installation;

Pre-requisites

Indoor building physics

Useful info

Contacts

Education manager

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Place

➤ Toulouse

Equipments Acoustics

 **ECTS**
4 credits

 **Component**
INSTITUT
NATIONAL
DES SCIENCES
APPLIQUEES
TOULOUSE

 **Number of
hours**
48h

Presentation

Description

Programme (detailed contents):

Diffuse field, direct field

Different sound absorbers

Determination of absorption coefficient

Auditorium acoustics

Acoustic power of building services

Design methods

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- Diffusion of sound waves inside and outside rooms
- Transfer of acoustic waves along ductworks
- Transfer of vibrations generated by building services

The student will be able to:

- Calculate walls absorption to restrict noise dose absorption by workers
- Reduce noise propagation in ducts
- Define noise proof walls to protect the surrounding
- Size vibration pads

Pre-requisites

Indoor building physics

Useful info

Place

➤ Toulouse