

## SEMESTER 3\_2nd YEAR ICBE

# Introducing

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## Description

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## Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

## Practical info

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## Location(s)

 Toulouse

## Mathematics

# Introducing

## Description

In the Analysis-Algebra course:

- Laplace transform and application to the resolution of first and second order linear ODEs.
- bilinear algebra: bilinear forms, symmetric bilinear forms, associated quadratic form, scalar product, orthogonality, Gram-Schmidt orthogonalization procedure, orthogonal of a vector subspace, orthogonal projection, norm associated with a scalar product, convergence, continuity, Weierstrass theorem.
- functions of several variables: continuity, partial derivatives, differentiability, local extremum points, multiple integrals.

In the Probabilities section:

- probability space and conditional probabilities, independence of events
- discrete and continuous random variables (law of probability, expectation, variance, etc.)
- couples of random variables
- limit theorems (law of large numbers, central limit theorem)

## Objectives

Introduce the Laplace transform and its use to solve certain ordinary differential equations.

Introduce some notions of bilinear algebra, in particular the scalar product and orthogonality.

Introduce concepts of analysis in several variables.

Introduce the basic concepts of probability.

## Necessary prerequisites

1st year linear algebra.

1st year analysis: functions of a single variable (continuity, derivative, integrals, local extremum points).

Newton binomial, geometric series, exponential series.

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## Practical info

### Location(s)

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## Transfer bases

# Introducing

## Description

Transport phenomena: Continuum media, concept of shear stress. Statics of fluids. Kinematics of fluids. Principles of conservation of mass, momentum and energy. Writing local equations and the global balances of mass, momentum and energy. Rheological laws (examples of Newtonian fluid and some non-Newtonian fluids).

Boundary conditions.

Exact solutions of some model problems. Analogies of transfers (Newton, Fourier, Fick).

UF “Thermodynamics - Basics and Applications” from the first year of INSA or equivalent.

First-year mathematics (differential and integral calculus, notions of geometry, trigonometry and algebra).

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## Practical info

## Objectives

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

- The basics of continuum mechanics
- The concept of balance and the different scales of application

The student will be able to:

- Define a system and its contours, and calculate inlet, outlet and transformation fluxes
- Write local and macroscopic balances of mass, energy and momentum
- Solve analytically simple problems of Newtonian fluid mechanics

## Location(s)

 Toulouse

## Necessary prerequisites

## Organic chemistry

# Introducing

## Description

Part I: Spatial and electronic structures.

- Hybridization of atomic orbitals and geometry of organic molecules.
- Nomenclature.
- Constitutional and conformational isomerism.
- Stereochemistry (enantiomerism, diastereoisomerism).
- Electronic effects: polarity, polarizability, inductive and mesomeric effects.
- Structure-reactivity relationship: the main classes of reagents: acids, bases, nucleophiles, electrophiles, reaction intermediates: carbocations, carbanions, free radicals.

Part Two: Reactivity of compounds. The main reaction mechanisms.

- Radical substitutions on alkanes (SR).
- Electrophilic additions to alkenes (AE).
- Electrophilic substitutions on arenes (SE).
- Nucleophilic substitutions in aliphatic series (SN1 and SN2).
- Elimination reactions (E1 and E2).

Basic practical work:

- Doubling of a racemic mixture.
- Chemical synthesis.

Acquire and implement the main experimental techniques (distillation, extraction, reflux set-up, recrystallisation, TLC and silica gel column chromatography).

- Raise students' awareness of safety during chemical manipulations.

UV visible spectrophotometry: principles, theory, Beer

Lambert's Law.

IR and NMR spectroscopy: principles, equipment, interpretation of spectra.

## Objectives

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

- the spatial and electronic structures of molecules in order to understand the main reaction mechanisms and their stereochemical consequences.
- the basic reaction mechanisms of chemical reactions in the living world and industrial organic chemistry.

The student should be able to:

- Identify the main chemical functions and name chemical compounds.
- Represent chemical compounds (Newman, Fischer, Cram).
- Distinguish between the different types of isomerism: conformational and configurational isomerism (enantiomerism, diastereoisomerism).
- Analyse electronic effects (inductive effects and mesomeric effects) in a molecule.
- Describe the different classes of reagents and reaction intermediates.
- Describe the main reaction mechanisms encountered in chemistry: Radical substitutions on alkanes (SR), Electrophilic additions on alkenes (AE), Electrophilic substitutions on arenes (SE), Nucleophilic substitutions in aliphatic series (SN1 and SN2), Elimination reactions (E1 and E2).
- Carry out organic syntheses using the basic experimental techniques of organic chemistry.
- Use the various techniques for characterising organic compounds (UV, IR, NMR)

- Interpret UV, IR and NMR spectra

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## Necessary prerequisites

I1ANETCH Atomistic  
I1ANETCH Solution chemistry

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## Practical info

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### Location(s)

 Toulouse

# Thermodynamics of physical-chemical systems

## Introducing

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### Description

Systems, quantities and properties of states  
Energy description of systems  
Macroscopic properties of pure components  
Description of physicochemical systems  
Reaction quantities  
Chemical potential and fugacity  
Real solutions  
Characterization of phase equilibria  
Chemical equilibrium

### Objectives

At the end of this module, the student will have acquired systematic practice in the implementation of material and energy balances with chemical reactions, and analyzes in closed and open energy systems. He will understand the behavior of real fluids, the generalized formulation of these behaviors using equations of state, their behavior in saturation zones, the main associated thermodynamic diagrams and their application to various systems.

He will have acquired the basics of thermochemistry including reaction quantities as well as the influence of temperature on these quantities (Kirschhoff), the heat of reaction, and will apply this knowledge to reactive systems under various conditions both theoretically through supervised work and practically in TP.

He will also have acquired the bases for the description of physicochemical systems and solutions (ideal/non-

ideal) allowing the characterization and calculations of equilibrium between phases in the solutions. These bases are necessary for understanding and sizing unit operations in chemical and biochemical systems.

He will understand and apply the concepts associated with chemical equilibria: limitation of reaction progress, stability, instability and spontaneity of chemical reactions, chemical equilibrium constant, displacement of the equilibrium (Lechatelier's law).

He will apply this knowledge to homogeneous equilibria in the gas phase and in the condensed phase as well as to heterogeneous chemical equilibria.

### Necessary prerequisites

UF « Thermodynamique Bases et applications » (code I1ANTH11) de la première année de l'INSA ou équivalent.

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### Practical info

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#### Location(s)

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# Structural Biochemistry

## Introducing

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### Description

Detailed description of the structure of the molecules listed below and their major role in the cellular functioning of living beings:

- Monosaccharides, oligosaccharides, and polysaccharides
- Fatty acids and lipids
- Nucleotides and nucleic acids (DNA and RNA)
- Amino acids and proteins

Description and implementation of several analytical methods to elucidate the structure of certain compounds.

Introduction to the study and use of these biomolecules for biotechnologies in the context of ecological transition, sustainable development, and the bioeconomy.

### Objectives

By the end of this module, students should have understood and been able to describe the overall structure of the four major classes of biomolecules that make up living systems (carbohydrates, lipids, nucleic acids, and proteins), as well as their function in cells. Students will also be aware of the great diversity that exists in the living world and its importance. They will also be able to cite certain techniques for analyzing these molecules and should be familiar with some simple examples of their relevance to biotechnology.

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## Necessary prerequisites

I1ANBC11 Chemistry

I2BECH11 Organic chemistry

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## Practical info

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### Location(s)

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## Expression

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## Description

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## Practical info

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## Location(s)

 Toulouse

## Contemporary economy and ecological transition

### Introducing

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#### Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

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#### Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

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#### Necessary prerequisites

None

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#### Location(s)

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## Foreign Language 1

# Introducing

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## Practical info

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## Location(s)

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## Internship defense

# Introducing

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## Description

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## Practical info

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## Location(s)

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## Professional path initiative

# Introducing

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## Description

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# Practical info

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## Location(s)

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## Physical Activities and Sports

### Introducing

#### Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

#### Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

#### Évaluation

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#### Practical info

#### Location(s)

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