

SEMESTER 6_3rd YEAR ICBE

Introducing

Description

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

Location(s)

 Toulouse

Numerical culture and skills 2

Introducing

Description

The flow of Machine Learning
Data preparation
Machine Learning Terminology
Data types
Data visualization, quality and size
Reliability
Some activation functions
Model performance
Environmental impact

Objectives

At the end of this module, which follows the 2A module, the student will have consolidated his knowledge of the field of AI: accuracy, loss function, overfitting, batch size, visualization techniques... He will also have prepared and passed a PIX certification.

Necessary prerequisites

Basics of Python programming

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Location(s)

 Toulouse

Biophysics

Introducing

Description

Programme (detailed contents):

- Introduction to Biophysics
- Protein structure
- Ion channels and electrophysiology
- Random walk in biology
- Organisation and dynamics of membranes
- Fluorescence microscopy and spectroscopy
- Stochasticity in gene expression
- Cell signalling

Objectives

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

Advanced methods in molecular and cellular biophysics:

- Fluorescence microscopy and correlation spectroscopy
- Flow cytometry, imaging flow cytometry, fluorescence/image-activated cell sorting
- Electrophysiology, nanopore sensing and sequencing
- PyMol to visualize protein structures
- Surface-sensitive techniques

Main concepts in molecular and cellular biophysics:

- Macromolecular crowding
- Noise as a general principle underlying biological organisation and functions (stochasticity in gene expression, random walk, protein conformational changes)
- Cell signalling in space and time

The student will be able to:

- Interpret data from biophysical experiments and link the results to the studied concepts
- Apply biophysical insights to solve new problems in biology and bioengineering.

Necessary prerequisites

Has already followed a general biology course at university level

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Location(s)

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Organic chemistry

Introducing

Description

Stereochemistry: prochirality, synthesis of enantiomerically pure compounds.

The carbonyl function (related organic and enzymatic reactions).

- Nucleophilic addition: main reaction of aldehydes and ketones
- Nucleophilic substitution on C sp²: main reaction of the derivatives

Multidisciplinary experimental project at the interface of chemistry and biology.

Objectives

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

- reaction mechanisms encountered in chemistry and biology.

The student must be able to:

- Understand and explain the reaction mechanisms.
- Carry out a multidisciplinary experimental mini-project in a group (design an experiment based on bibliographic research, propose an analytical monitoring approach, implement an experimental approach and analytical techniques, generate data, interpret, criticize and promote the experimental results, communicate orally).

Necessary prerequisites

I1ANETCH Chimie

I2BECH10 Chimie organique

I2BEBS10 Biochimie Structurale

I2BEAN20 Méthodes d'analyse I

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Structural chemistry

Introducing

I2BEBS10 Biochemistry
I2BEAN20 Analysis methods

Description

Training at spectroscopic methods applied to a rational approach of the structural determinations in deepening and broadening the theoretical basis of Nuclear Magnetic Resonance, Infra Red spectroscopy Ultra Violet and the Mass Spectrometry. Use of the complementarity of these different techniques for the determination of structure of molecules.

Principle and application of analytical methods, (NMR, MS, IR, UV) in Chemistry/Biochemistry. Spectroscopy NMR 1D and 2D: ^1H , ^{13}C . Mass spectrometry: EI, CI, Electrospray, MALDI, SIMS,

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Objectives

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

- the theory and practice of the main analytical techniques used in chemistry and biochemistry.

The student must be able to:

- solving structure of chemical compounds and simple biochemistry molecule using analytical methods: NMR, Mass Spectrometry, IR, UV.

Necessary prerequisites

I1ANETCH Chemistry
I2BECH10 Organic chemistry

Bioseparation

Introducing

Description

Bioseparation : Precipitation: definition, review of precipitation processes, type of precipitation. Centrifugation and ultracentrifugation: introduction principle theory of sedimentation, and centrifugation, centrifuge equipment and operations. Membrane separation: principles and theory, membrane type and module, membrane fouling. Electrophoresis: principle and theory, electrophoresis equipment, gel electrophoresis, SDS-PAGE, isoelectric focusing, 2-D electrophoresis, capillary electrophoresis.

Objectives

Bioseparation: At the end of this module, Students should understand and be able to explain

- the mechanisms exploited by the separative techniques commonly used in biochemistry and biotechnology, particularly in the case of biocatalysts
- the properties of biological molecules exploited in the application of separative techniques
- Precipitation (proteins, nucleic acids),
- centrifugation and ultracentrifugation,
- membrane separation (MF, UF, NF, dialysis, electrodialysis)
- electrophoresis

Necessary prerequisites

I1ANETCH Chemistry
I2BECH10 Organic Chemistry
I2BEBS10 Structural Biochemistry
I2BEAN20 Analytical Methods
I2BEGR20 Reaction Engineering

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Enzymology

Introducing

Description

Enzymology: Detailed description of

- Classifications of enzymes, general and specialized databases
- Kinetic models: Michaelian enzymes, inhibition mechanisms, kinetic models of multi-substrate enzymes, allosteric enzymes and regulation
- Principles of nucleic acid and protein sequence alignment (local and global alignment)
- Biophysical methods used to determine 3D protein structure
- Visualization of catalytic site and analysis of catalytic mechanisms

Objectives

At the end of this module, students should understand and be able to explain

- the importance of studying enzymes and the use of these biocatalysts in biotechnology in the context of ecological transition, sustainable development related to the bioeconomy.
- the methods for measuring the velocity of an enzymatic reaction
- the equations applied to model the kinetics of enzymatic reactions
- the influence of the main physico-chemical parameters on the catalytic efficiency.
- the methods used to determine and analyze the enzyme three-dimensional structure

Students will also learn to use:

- databases of nucleic acids as well as databases of

protein sequences and three-dimensional structures
- computational tools used for sequence alignments (nucleic acids or proteins), visualization of tertiary protein structures and for structure-function relationship studies.

Necessary prerequisites

I1ANETCH Chemistry
I2BECH10 Organic Chemistry
I2BEBS10 Structural Biochemistry
I2BEAN20 Analytical Methods
I2BEGR20 Reaction Engineering

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Bacterial genetics

Introducing

Description

The mechanisms leading to mutations, whether specific or broader, will be reviewed (mutagens, horizontal transfer mechanisms, transposition). The course will address prokaryotic transcriptional and translational regulations. It will present the biotechnology applications of this knowledge, as well as the tools for regulation, expression measurement and screening.

Objectives

The objective of this EU is to address the mechanisms that allow bacteria to evolve their genetic sequence and best respond to environmental conditions.

Necessary prerequisites

French.

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évaluation par les pairs...

Practical info

Location(s)

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Business Game

Introducing

Description

Simulation of 5 years of company life (decision making in production, finance, marketing) using the SIMGEST business game.

Objectives

The student must have understood and be able to explain the interdependence of the company's functions (production, commercial, financial, human resources) through decision-making and analysis of the company's economic and financial results. He will have to understand how a company operates, construct financial statements, calculate costs, create simple management tools, optimize resources to make the company profitable, present an oral report of activities (in English)

Necessary prerequisites

financial management cours in 3A

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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...

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Location(s)

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Company Finance

Introducing

Description

Income statement, Cash flow, Balance sheet. Elements on costs. The break-even point. Taking inventory into account in financial statements. Debt financing. Company profitability.

Objectives

The student must have understood and be able to explain the company's financial summary documents as well as the basics of cost calculation in the industrial company.

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...

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Business Communication

Introducing

Description

Students will create a fictitious start-up in a market of their choice, conducting market analysis and identifying competitors. They will produce a GoFUND Me video and practice holding meetings and solving business challenges in English. The final presentation will be a “Shark Tank”-style competition, where students pitch their business idea to a panel of investors.

Objectives

This course aims to equip students with essential business communication skills. Students will learn to understand a simple business plan and market research, conduct meetings, and use key business vocabulary. They will develop skills to describe graphs and create high-impact presentations. Students will also practice pitching to investors, introducing a company, and discussing social and environmental responsibility in the workplace.

Necessary prerequisites

None

Évaluation

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Practical info

Location(s)

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Physical Education

Introducing

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Évaluation

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Practical info

Location(s)

 Toulouse

Professional Path Initiative 3rd Year

Introducing

Description

Évaluation

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Practical info

Location(s)

 Toulouse

Societal Openness Modules

Introducing

Description

- Openness to societal issues (Energy transition, Ecological transition, Digital society, Health global, Mobility and infrastructure)
- Themes with interdisciplinary approaches, mixing Sciences & Techniques and Human Sciences and Social or Thematic in SHS complementary to the base proposed by INSA Toulouse.

Each year, the Opening Modules Commission draws up the list of MOs which will be offered in the 2nd semester. Students then choose the MO they wish to experience via a wish phase on a dedicated application. Students are informed of the MO they will follow during the month of January.

- Offered in the 2nd semester of 3A, Monday afternoon from 2 p.m. to 4:45 p.m.
- Open to all specialty pre-orientations (PO)
- Duration: 30 hours student (NB: additional personal work of around 30 hours is expected)

Educational format:

- Active pedagogies
- Face-to-face, hybrid or fully remote
- ECIU+ Challenge Based Learning possibility

Objectives

The Societal Openness Modules are courses open to the 5 societal issues addressed by INSA Toulouse, allowing complex situations to be understood and covering themes not covered in INSA courses.

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

Location(s)

 Toulouse

Analytical methods II

Introducing

Description

1. formulate a scientific problem related to analysis methods in order to illustrate it by manipulations.
2. Make a bibliography with the aim of proposing, adapting or creating experiments which will illustrate the chosen issue.
3. Gather its theoretical and practical knowledge of the previous years and implement them to solve the chosen problem.
4. Plan the experimental work of the group and organize the interactions with the other groups.
5. Explain the principle and learn how to implement the experimental techniques for the analysis.
6. teach yourself on the new analysis techniques necessary to undertake the project when this methods haven't been taught previously.
7. carry out an experiment at the laboratory
8. Analyze the experimental results.
9. Share and debate the results in the scientific point of view with both your teachers and inside your students group. Suggest improvements or work lead.
10. Verbally explain the objectives desired, the chosen scientific approach, and the results of the debate during an oral presentation.
11. Give explanation on the scientific approach followed and the results reached in a written scientific report.

Objectives

Learning by experimental project: illustrate a scientific problem using various experiments involving analytical techniques.

Forcing students to use all of their scientific knowledge in order to analyze the experimental results of their experiments and if necessary modify the protocols

Necessary prerequisites

- Molecular structure and reactivity.
- Thermodynamics, chemistry, electrochemistry.
- Techniques of separation, extraction.
- Analytical methods: chromatographic, UV-visible, electrochemical.

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Practical info

Location(s)

 Toulouse

Mass transfer

Introducing

Description

Thermodynamic properties of gas/liquid equilibria in the perfect gas state, concepts of fugacity and Henry's equilibrium. Transfer properties (viscosity, thermal conductivity, diffusivity) and phase equilibria of multi-constituent real fluids.

Introduction to matter transfer: establishment of the continuity equation, resolution of this equation in a few special cases. Introduction to the notion of transfer coefficient, dimensional analysis, transfer models (film and double film), experimental determination of transfer coefficient, concept of Height of Transfer Unit (HUT) and Number of Transfer Unit (NUT). Introduction to basic sizing of some G/L exchangers (packed column, bubble column, spray column).

Objectives

At the end of this module, the student will be familiar with the equations needed to determine the thermodynamic equilibrium properties (fugacity) of real fluids in multiphase systems. This knowledge will be applied to the determination of exchange potentials and transfer properties (viscosity, diffusivity, etc.).

Students will master the notion of transfer coefficient and be able to estimate it in a given operation.

Students will be able to apply these quantities to the generalized material balance equation applied to multiphase contactors, and will be able to dimension industrial installations such as bubble, packed and spray columns.

The student should be able to: size industrial installations such as bubble, packing and spray columns.

Necessary prerequisites

Advanced thermodynamics and application to physicochemical systems: I2BETH11

Roustan M., Transferts gaz-liquide dans les procédés de traitement des eaux et d'effluents gazeux, Editions TEC & DOC, 2003

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Practical info

Location(s)

 Toulouse

Chemical reaction engineering 2

Introducing

Description

Material balances in ideal reactors: general form of the balance, application to different ideal reactors, application to complex reaction schemes, yields and selectivities. Combining ideal reactors to optimize conversion and yield.

Influence of temperature on reactor performance. Notion of Optimal Temperature Progression (OTP). Energy balances for ideal reactors.

Description of real reactor flows. Residence time distribution. Hydrodynamic interpretation and modeling. Application to a packed reactor.

Mixing/reaction interactions: mixing mechanisms, methodology for identifying and solving a mixing/reaction problem, analysis and calculation of characteristic times, probability density function, micromixing models. Modeling/simulation of a case study.

Objectives

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

- reactors with variable volume / flow rates
- yield and selectivity in multiple stoichiometry reaction systems
- reactor arrangements (series, parallel, plug flow with recycling)

- mixing mechanisms and their relationship to reaction progress
- influence of reactor non-ideality on conversion: residence time distribution (transfer function concept) and concentration distribution (mixing)
- the influence of temperature on reactor performance, notion of Optimal Temperature Progression
- the general equation for energy conservation in a reactor.

The student should be able to :

- calculate ideal open reactors under variable flow conditions
- calculate the size or yield or selectivity of ideal open reactors for multiple stoichiometry systems, and the conversion rate that can be achieved by arranging the reactors
- determine the DTS of a reactor
- apply a mixing or flow model to predict conversion in a non-uniform reactor
- calculate the POT for a given system
- establish and solve enthalpy balances for reactional and non-reactional systems.

Necessary prerequisites

Ideal reactors, reaction rates and reaction progress parameters

Linear differential equations

Basis of Laplace transforms

Basis of transport phenomena

Basis of thermodynamics

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Practical info

Location(s)

 Toulouse

Thermodynamics and energy

Introducing

Description

Évaluation

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Practical info

Location(s)

 Toulouse

Water, Environment and Risks

Introducing

Description

1- Environmental legislation and regulation
Basics of law and regulatory instruments (TD)
Design office project: Water in a region: from use to discharge

2- Environment
- Pollutant dispersion (mechanisms, consequences)
- Characterisation and typology of waste, waste management (treatment and storage methods), ordinary and radioactive waste, environmental impact of waste.

3- Process safety
Definitions of the main types of risk in the field of processes: calculation of the probability of human impact, toxicity, different types of explosion, thermal runaway. Protection methods and devices.

4- Water: issues for actors and industries
Environmental and health issues, indicators of pollution
Main treatment stages and processes

Objectives

- Explain the principles of environmental law in France and be familiar with legal and regulatory information tools.
- Describe the main environmental problems, the principles of water and waste management and the main treatment processes.

- Know the main risks in the process industry and the mechanisms of accidents.

Necessary prerequisites

Chemistry for solutions / Unit operations . Mass and Energy balances / kinetics and thermodynamics

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Practical info

Location(s)

 Toulouse

Careers in Chemical Engineering (1)

Introducing

Description

presentation of various possible careers in process engineering: design office engineer (preparing calls for tender, responding to calls for tender, business management, contracts and public finance, etc.), project manager, R&D engineer, teacher-researcher, consulting and environmental management engineer, regional engineer.... . The tools specific to these professions (which form part of their knowledge and skills), the ways of accessing them and career paths are discussed.

Objectives

At the end of this CE, students will be able to:

- Identify the sectors of activity of GP3E engineers; the different possible professions (design office, territorial engineer, environmental management, research and development, production, consulting, business engineer, etc.), their specific features and the conditions for accessing them.
- build a professional network based on meetings and information provided by speakers

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Reliability
Some activation functions
Model performance
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Necessary prerequisites

Basics of Python programming

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Business Game

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financial management cours in 3A

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Location(s)

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Company Finance

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Business Communication

Introducing

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Necessary prerequisites

Physical Education

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Professional Path Initiative 3rd Year

Introducing

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Societal Openness Modules

Introducing

Description

- Openness to societal issues (Energy transition, Ecological transition, Digital society, Health global, Mobility and infrastructure)
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