FOURTH YEAR INSA TOULOUSE

Autumn semester

Cellular metabolism and regulation	5 credits	65h
Genetic engineering	6 credits	74h
Mass transfer	6 credits	51h
Biochemical kinetics and bioreactor	6 credits	69h
Improving autonomy and building a professional project	4 credits	39h
Improve your management abilities	4 credits	45h

Spring semester

Microbial and Mammalian cells culture	7 credits	98h
Genetic and Enzymatic engineering	4 credits	72h
Multi-disciplinary Projects	7 credits	119h
Unit Operations	6 credits	89h
Communicating within organizations	6 credits	75h

Cellular metabolism and regulation

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
65h

In brief

Teaching language(s): Français, Anglais

Presentation

Objectives

Description of the main metabolic pathways. Thermodynamics and kinetics. Stoechiometric balances. Description of some pathway regulation. Interconnection between the different pathways within the carbon central metabolism.

Useful info

Place

Toulouse

Genetic engineering

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
74h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

- mutations

- transformation

- conjugaison

- transduction

- transposons

Basic tools (enzymes, plasmids, oligonucleotides..)

- Gene cloning

- Expression of recombinant proteins

- Analysis of a gene and its functions (sequencing, gene expression analysis, mutagenesis, protein-protein interactions, ...)

Organisation:

At the beginning of the course, the student will receive a document containing the most important points of the course. Along the course, about two hours will be used to analyse scientific papers in the domain and to solve a general scientific question by proposing adapted molecular biology methods. Simple molecular biology experiments will be performed to allow the student to apply the different concepts seen during the course: microbiology, transduction, genetic engineering tools, use of antibiotics, microscopy, During labwork sessions the student will also manipulate a Molecular biology software. A Group work made on a scientific paper will be presented to the class.

Main difficulties for students:

* To integrate different techniques in a general scientific question

* To find the methods which will allow to solve a problem

Objectives

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

- Basics of bacterial genetics.

- Basic tools used in genetic engineering (restriction enzymes, plasmids…)

- Basic methods like cloning, PCR, sequencing, direct mutagenesis, microarrays, libraries construction, gene expression analysis…

The student will be able to:

- to describe and summarize basic methods

- to insert these methods in a larger scientific and experimental context

- analyse and criticize a scientific paper in this domain

- perform a simple experiment of molecular biology

use an "in silico cloning" software

Pre-requisites

Microbiology / Basic molecular biology

Useful info

Place

Toulouse

Mass transfer

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
51h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Fundamental laws of mass transfer phenomena : conduction, convection. Steady state and transient state. Mass balance. Transfer in several phases. Reaction and transfer. Application to biotechnologies (oxygen transfer). Heterogeneous catalysis. Optimal design methodology and experimental strategy. Experimental designs. Factorial designs. Response surface. Optimal responses determination. Study of mixtures.

Organisation:

Lectures, tutorials with exercises (application to bioprocess) and lab works

Objectives

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

To understand mass transfer phenomena (diffusion, convection).

The student will be able to:

- read, interpret, propose an installation flowsheet
- to write global balances on a process in order to calculate matter and energy flows
- identify of information fluxes
- make an critical analysis of a process
- be able to design an optimal set of experiments

Pre-requisites

Thermodynamics of solutions / Differential and partial derivative operations

Useful info

Place

Toulouse

Biochemical kinetics and bioreactor

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
69h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Biochemical reactions, reactors and microbial engineering

Reactors instrumentations

Microbial kinetics

Material Balances, stoichiometric and yield relationships

Thermodynamic Balances

Idealized reactors (Batch, Continuous Stirred Tank Reactor, Tubular Reactor), combinations of ideal reactors, recycling reactors and real reactors

Distribution of residence times

Modeling real reactors with combination of ideal reactors

Organisation:

Lectures, Tutorials.

Practical courses,

1) Saccharomyces cerevisiae culture. Kinetic and mathematical analysis

2) Enzyme reactor design

Objectives

Understanding and implementing the biological reactions

Elements in biochemical engineering. Description of the bioreactor and its instrumentation. Mass, elementary and energetic balances. Application to ethanolic fermentation. Numerical experimental data treatment

Pre-requisites

Chemical and enzymatic kinetics / Differential and matrix calculations

Useful info

Place

- Toulouse

Improving autonomy and building a professional project

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
39h

Presentation

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).

Place

Toulouse

Useful info

Improve your management abilities

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES 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
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Place

Toulouse

Microbial and Mammalian cells culture

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
98h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Basic concept of cellular biology, establishment of a cell line, normal and transformed cells, culture media and culture systems, contaminations, transfection, different uses of mammalian cells

Kinetic models of growth and metabolites production , effects of the variables and environmental parameters, interaction between the biological dynamics and the mass transfers, equations of the bio-reactors: batch, chémostat, plug flow reactors, fed-batch, reactor with cellular recycling, application to the metabolites productions, numerical processing of the experimental data.

Organisation:

At the beginning of the course the students will receive a document containing the major informations given in the course and a document with the informations "step by step" to manipulate themselves two cell lines.

The " uses of mammalian cells" will be treated by the students themselves, groups of 3 students will work on different examples and will present the results of their work.

Main difficulties for students:

-practice of mammalian cell cultures

-mathematical approach of the various concepts of biochemical engineering

Objectives

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

- How to establish a cell line in culture
- Mammalian cell culture specificities in terms of conditions and media
- Major uses of mammalian cells
- - Various kinetic behaviours of microbial growth and production
- Several strategies from implementation of the microbial cultures in the bio-reactor

The student will be able to:

- use a vocabulary specific to cell culture
- name major characteristics of a mammalian cell
- manipulate a cell line
- analyse, comment and criticize a scientific paper in the domain
- to calculate the various kinetic and stoechiometric parameters of microbial cultures

to calculate the potentialities of productions for the various bio-reactors

Pre-requisites

Basic knowledge of cellular biology

Basic concepts of molecular biology

Courses on kinetics, microbiology, metabolism, reactor engineering

Useful info

Contacts

Education manager
STEPHANE GUILLOUET
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Place

Toulouse

Genetic and Enzymatic engineering

ECTS
4 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
72h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Enzymatic engineering

Overview of protein structures, Computational tools and softwares for DNA and protein sequence analyses sequence analyses / Iinitiation to molecular graphism and molecular modelling / analyses and comparisons of 3D structures/ Case study: a-amylase family.

Genetic engineering

Genetic engineering will be taught through the preparation of literature review reports related to genetic engineering and synthetic biology (genome editing, metabolic engineering, control of gene expression, etc..). This will be completed by the oral presentation and critical analysis of a scientific article in front of the student class.

Organisation:

Lectures, practical courses, literature review, oral presentation.

Objectives

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

Enzyme engineering

Understand the bioinformatics methods and computational tools used for i) genome assembly and annotation, ii) genome and protein sequence and structure analysis iii) comprehension of enzyme mechanism and engineering.

Genetic engineering

Understand the main approaches used for genetic engineering and synthetic biology. Understand the methodology used for scientific article search in data bases, for writing a scientific literature review and presenting a critical analysis of scientific articles.

The student will be able to:

Enzymatic engineering

Describe the methods used for bioinformatics analysis of genome and protein structures (sequence alignment and molecular modelling and graphism tools). Apply computational

methods to structure-activity relationship studies and enzyme engineering.

Genetic engineering

Use of bibliographic database for scientific article search.

Construct and write a scientific literature review

Know and describe various approaches and methods entering in the field of genetic engineering.

Pre-requisites

Structural biochemistry and molecular biology

Useful info

Place

Toulouse

Multi-disciplinary Projects

ECTS
7 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
119h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

The program includes 4 parts:

- Methodology for project management

- Principles of the " quality, safety and environment respect" approach

- Multidisciplinary project that mobilizes knowledge in biochemical engineering, transfer phenomena, bioreactors engineering, balance sheet and unit operations

- The practice of individual and collective sports activities

Organisation:

The application of the learnings is made in group activities

The QSE approach is applied on practical class.

Objectives

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

- The methods for project rational management

- The main concepts and the tools for quality

- The specific requirements for safety and environment in project management.

The student will be able to:

- Implement only and/or in a team the projects of actions,

- Manage in specialist the implementation and the follow-up of a project

- Plan actions and anticipate those of the others,

- Regulate the activity during project implementation,

- Make choices adapted to the interactions between the actors in order to be efficient,

- Communicate to obtain the wish action,

- Allocate roles between the partners by taking into account the individual skills,

- Act according to the constraints and to the adversity.

Pre-requisites

I1CCGE40 / I2CCGE10 / I3CCGE10 / I3BEMT10 / Biochemical engineering/ Transfer phenomena

Useful info

Place

Toulouse

Unit Operations

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
89h

In brief

Teaching language(s): Français, Anglais

Presentation

Description

Fundamental laws of heat transfer phenomena : conduction, convection and radiation. Thermal resistance. Conduction in solids : steady state and transient state. Natural and forced convection. Heat and mass exchanger: theory, calculations, technology.

Organisation:

Lectures, tutorials with exercises (application to bioprocess) and lab works

Objectives

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

heat transfer phenomena: conduction, convection and radiation.

Mass transfer : principles of distillation and absorption

The student will be able to:

Size heat and mass exchangers

Useful info

Place

Toulouse

Communicating within organizations

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
75h

Presentation

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 CEFRL for the 5 language activities, depend on the language studied - Chinese, German, Spanish - and the level of the student.

They can be consulted on :

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

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