Autumn semester

Unit operations 1	5 credits	59h
Unit operations 2	5 credits	81h
Processes simulation and analysis	5 credits	69h
Heterogeneous reaction engineering	6 credits	67h
Chemical and environmental engineer, define and build a project	5 credits	61h
Improve your management abilities	4 credits	45h

Unit operations 1

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
59h

Presentation

Description

Programme (detailed contents):

* Intermolecular and interfacial interactions occurring in physical and chemical processes (interfaces and colloïds - molecular interactions - surface tensions - capillarity - wettability - adhesion - Surfactants - Interfacial forces : application to colloids), coalescence...

* Membrane, filtration media and fouling (types of processes, media, membrane- operating parameters and fouling phenomena for pressure-driven membrane processes, retention phenomena),effect of operating conditions on the process selectivity and productivity, mass balances and design of deep-bed filters, of membrane processes.Energy consumption.

* Mixing

Macroscopic characterization of the mixing

Technology of mixers : stirred tanks and static mixers

Mixers design

Objectives

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

- the basic concepts of interface and colloidal systems

- phase equilibrium diagrams

- general concept for mass transfer unit operations (ideal stages, operating line...).

Kinetic limitations and theirs effects on separation and mixing

- different ways to perform separation processes

- basic concepts of deep-bed filtration and membrane separation (UF/MF/NF)

The student will be able to:

- identify interactions between compounds or interface/ compounds involved in separation and mixing operations

- identify main membrane fouling phenomena for a given application

- use the equilibrium diagrams

Pre-requisites

Thermodynamics.

Fluid properties and mass transfer.

Hydraulics and dispersed systems.

Basic concepts of Chemistry and Physics .

Useful info

Contacts

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Place

Toulouse

Unit operations 2

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
81h

Presentation

Description

Programme (detailed contents):

* General concepts for mass transfer unit operations (presentation, ideal stages, operating lines, equilibrium stage, kinetic concepts)

* Unit operations of mass transfer

Technology of different separators

Design tools of separators. Application to extraction, distillation (continuous and batch), absorption, adsorption..

Organisation:

Lectures, tutorials and lab work.

Objectives

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

- Phase equilibrium diagrams

- General concept for mass transfer unit operations (Ideal stages, operating lines...). Kinetic limitations and theirs effects on separation

- Different ways to perform separation processes (single contact, cross-current and counter-current contactors)

- design tools for separators.

The student will be able to:

- use the equilibrium diagrams

- choose the required technology for a separation

- choose the contact mode

- write the mass balance

- design a multistage separation device (extraction, distillation, adsorption, absorption...)

- then propose a contactor technology.

Pre-requisites

Transport and reaction in fluid medium.

Thermodynamics.

Fluid properties and mass transfer.

Basic concepts for unit operations.

Useful info

Place

Toulouse

Processes simulation and analysis

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
69h

Presentation

Description

Programme (detailed contents):

- local scale: Computational fluid dynamics, principles, applications, solving the equations, turbulence modelling. Software FLUENT

- unit operation or process scale: simulation (material and energy balances, elements of design of apparatus) on different processes operating in continuous operation and simulation of batch chemical reactors or distillation columns. Software PROSIM

- process scale: methodology for environmental impacts assessment. Life cycle analysis. Carbon footprint. Data utilization. Software Umberto

Organisation:

Introduction lectures, tutorials on computer, individually or in pairs. Project: performing a Life cycle analysis on a process.

Objectives

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

- the basics of chemical engineering process simulation tools at various scales

- the life cycle and carbon balance principles

- the basics of multidimensional analysis

- the elementary notions about process optimisation

The student will be able to:

- select the appropriate simulation tool with respect to the scale of investigation

- synthesize their knowledge to analyze the results of a commercial simulation tool

- simulate industrial processes in steady state

- perform the Life Cycle Analysis of an existing process

- use the FLUENT software to simulate single phase flows

- use the PROSIM Plus software to simulate general steady state processes

- use the UMBERTO software to perform a global analysis of a process within its environment.

- gather knowledge from various fields to choose the modelling approach, perform the set-up of the simulation and analyse the results

- perform an optimisation study with PROSIM

- set up simulations of unsteady state processes with PROSIM Batch and FLUENT

Pre-requisites

Modelling and numerical solution for fluid mechanics

Thermodynamics

Basic concepts for OPU

Technology and design of OPU

Hydraulic and dispersed systems

Transport and reaction in fluid medium

Useful info

Place

Toulouse

Heterogeneous reaction engineering

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
67h

Presentation

Description

Program (detailed contents):

- Interest and technologies for heterogeneous reactors.

- Catalytic reactors: Notions of catalyst and heterogeneous kinetics; Limitations by external or internal mass transfer, Calculation of effectiveness factors, Thiele Modulus, Modelling and design of fixed bed reactors (mass balances).

- Gas/liquid reactors: Gas/liquid mass transfer with chemical reactions; Hatta Number; Enhancement factor, Working regimes; Modelling and design of gas/liquid reactors; Choice of the reactor type.

- Biological reactions and reactors: analysis of stoechiometry and kinetics of biological reactions; Bioreactor analysis: design and operation of batch, fed-batch and continuous bioreactors, with or without recycling based on simple reaction kinetics with the goal of cell or metabolite production and pollution treatment

Organisation:

Lectures, tutorials, labwork.

Cases study project in small groups: definition of the physical problem and writing of the equations for a complex system including the transport and heterogeneous reaction steps and its resolution using a numeric tool.

Objectives

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

- the different types of chemical and biological catalysts and their working modes

- the stoichiometry, kinetic laws and their combination for the description of microbial cell behaviour for growth and production,

- the notion of limiting step(s) in heterogeneous reactions

- the notion of apparent reaction rate

- the expression and meaning of dimensionless numbers (Hatta, Thiele, Weiss, Biot...)

- the notions of effectiveness factor and enhancement factor

- the description and modelling of batch, fed-batch and continuous, single or multi stage biological reactors with or without recycling.

The student will be able to:

- determine the limiting process(es) in a chemical heterogeneous reaction

- express the apparent global rate of a chemical reaction depending on the working conditions

- identify the general metabolic scheme of microbial growth

- establish the stoichiometric equations and kinetic laws for biological reactions with respect to the environment conditions

establish an intrinsic kinetic law

- select and design the most suitable reactor to perform a given reaction

- integrate and prioritize the mechanisms in order to model homogenous and heterogeneous biological and chemical reactors

Pre-requisites

Transport and reaction in fluid media

Fluid properties and mass transfer

Thermodynamics

Thermal transfers and reactors

Microbiology and statistics

Useful info

Place

› Toulouse

Chemical and environmental engineer, define and build a project

ECTS
5 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
61h

Presentation

Description

Programme (detailed contents):

Part Standardization / Management System

- Understand the tasks of a manager (QS) E

- Know the principles of ISO standards including product quality, safety, environment

- Know how to apply / implement an ISO-type approach

- Understand the implementation of environmental management system by offering / using tools

prioritization of environmental issues within a company

Program :

management system related to ISO 9000 - 14000-18000: installation, diagnostic, monitoring

Knowledge of engineering professions: presentation of different trades and activity area that can be offered to young engineers in process and environment engineering: engineering, production, R & D, teacher and researcher, consultant and environmental management, territorial engineer, project engineer. Tools specific to these businesses (which are part of their knowledge and skills), how to access and career development are discussed.

Theoretical principles will be illustrated in a project. The practice of an individual or collective sport will allow the students to develop skills like teamwork, be involved but also observe, himself question

Organization (course):

Lectures from external actors engaged in the trades concerned are organized (around 20 speakers, with time activity ranging from 1 to 25 years). Students begin to weave their network and can better identify the jobs they want to exercise, when they leave the university

Objectives

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

AA1: Identify business sectors :engineering, territorial engineering, environmental management, research, development, production, consulting, sales engineer ...), their specificities, their tools and conditions for access.

AA2: Identify major constraints in industrial production,

know the key steps of responses to supply and achievement of business calls, the principles of public and private markets, the basics of environmental management and sustainable development.

AA3: applying the acquired scientific and technical training in process engineering in the context of industries and trades

AA4: namely build a professional network of contacts from meetings and information presented by the speakers

AA5: get involved in a group and a project to adapt, dare drive the action, ie abandon, propose ...

Pre-requisites

All the Chemical Engineering training

Useful info

Place

› Toulouse

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

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Place

Toulouse