SCIENCES, TECHNOLOGIES, HEALTH

CHEMICAL ENGINEERING

Niveau d'étude visé
BAC +5

Durée
2 année(s)

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

plugin.odf:Domaine régional
Génie des procédés

Présentation

Objectifs

The education programme in Chemical Engineering at INSA Toulouse aims to develop skills which are necessary for an engineer to develop, design, operate, optimise, manage or commercialise chemical or biochemical processes. These chemical engineers work in industries in the environmental sector (water/air/waste treatment) or in various other fields (chemistry, petrochemistry, food, pharmacy and cosmetics, specialised materials) and are able to take into account environmental and energetic criteria (eco-processes).

The training develops:

- generalist skills in Chemical Engineering which can be applied to all industries

- the ability to take into account environmental contexts using a knowledge of regulations and water science and environmental engineering and associated metrologies

- the ability to work in a team on multi-disciplinary projects in Chemical Engineering : design of industrial plants

- the ability to manage a project integrating organisational, economic, financial, human and technical aspects

In addition to the generalist skills in Chemical Engineering, the training offers two major specialisations:

- Green-Processes (clean and sober Processes), which develops skills to consider environmental and energetic constraints in order to design and operate processes for all industrials sectors : design of environmental-friendly products, design and control of clean and sober processes, treatment and valorisation of industrial wastes

- Eco- industries (Treatment processes), which develops skills to design or operate processes adapted to the treatment of pollutions (water, air, wastes, grounds, drinking water production).

Et après

Conditions d'accès

Diplôme d'ingénieur habilité par la commission des titres d'ingénieur, 5 années d'études après la fin des études secondaires, confère le grade de Master.

Baccalauréat ou équivalent pour une admission en première année

Admission sur titre possible en année 2, 3 ou 4.

Admission

A tous les niveaux, l'admission aux INSA s'effectue par concours sur titres, dossier et éventuellement entretien ; le dossier rassemble des éléments d'évaluation obtenus par ailleurs par le candidat.

Et après

Poursuite d'études

Les étudiants peuvent préparer, en même temps que leur diplôme d¿ingénieur, un Master de Génie des Procédés.

Les thèmes de recherche concernent l'application du génie des procédés aux procédés de traitement et d'épuration d¿eaux (industrielles, potables, résiduaires), d'effluents gazeux et de résidus solides (graisses et boues).

Des stages de recherche sont proposés dans le laboratoire associé (LISBP) ou sur site industriel.

Plusieurs travaux ont conduit à la réalisation industrielle de dispositifs d'épuration.

Insertion professionnelle

Ingénieur études et travaux, chargé de concevoir des unités de traitement (eau, air, déchets) ou de production industrielle en respectant des contraintes environnementales et énergétiques.

Ingénieur d'éco-procédés industriels pour l'industrie chimique, pétrochimique ou agroalimentaire, chargé de mettre au point ou d'améliorer des produits ou des procédés pour réduire leurs impacts sur l'environnement en réponse à des normes ou à des demandes techniques ou sociétales.

Responsable de services techniques (ingénieur territorial) pour des collectivités publiques.

Responsable d'exploitation pour des écoindustries avec, par exemple, la responsabilité du bon fonctionnement d'une usine de traitement ou de production d'eau.

Responsable environnement sur un site de production industriel mettant en œuvre des procédés chimiques ou biochimiques, chargé du pilotage et du contrôle de la politique opérationnelle de l¿entreprise en matière d'environnement.

Infos pratiques

Lieu(x)

Toulouse

Programme

FOURTH YEAR INSA TOULOUSE

Autumn semester

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

Spring semester

Heat exchangers with or without phase transition and simultaneous heat and mass transfer	5 crédits	68h
Processes & energy	5 crédits	42h
Project for research introduction	5 crédits	12h
Metrology Environnement and Risks	6 crédits	67h
Improving autonomy and building a professional project	4 crédits	39h
Communicating within organizations	6 crédits	75h

FIFTH YEAR INSA TOULOUSE

Autumn semester

Design and environmental assessment of processes	9 crédits	47h
Human Resources Management and Group Work	6 crédits	75h

OPTION 1

Engineering of drinking water production and water treatment		86h
Rational use of energy		75h

OPTION 2

Waste treatment and valorization	5 crédits	76h
Separation processes for specific quality water production and new resource exploitation	5 crédits	51h

OPTION 3

Process control & optimization	5 crédits	75h
Reactor Design & Flow Assurance	5 crédits	52h

Spring semester

Training period (4th year)	9 crédits	1h
Training period (5th year)	21 crédits	2h

Unit operations 1

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
59h

Présentation

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

Objectifs

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

Pré-requis nécessaires

Thermodynamics.

Fluid properties and mass transfer.

Hydraulics and dispersed systems.

Basic concepts of Chemistry and Physics .

Infos pratiques

Contacts

Education manager
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Lieu(x)

Toulouse

Unit operations 2

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
81h

Présentation

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.

Objectifs

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.

Pré-requis nécessaires

Transport and reaction in fluid medium.

Thermodynamics.

Fluid properties and mass transfer.

Basic concepts for unit operations.

Infos pratiques

Lieu(x)

Toulouse

Processes simulation and analysis

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
69h

Présentation

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.

Objectifs

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

Pré-requis nécessaires

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

Infos pratiques

Lieu(x)

> Toulouse

Heterogeneous reaction engineering

ECTS
6 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
67h

Présentation

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.

Objectifs

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

Pré-requis nécessaires

Transport and reaction in fluid media

Fluid properties and mass transfer

Thermodynamics

Thermal transfers and reactors

Microbiology and statistics

Infos pratiques

Lieu(x)

› Toulouse

Chemical and environmental engineer, define and build a project

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
61h

Présentation

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

Objectifs

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 ...

Pré-requis nécessaires

All the Chemical Engineering training

Infos pratiques

Lieu(x)

› Toulouse

Improve your management abilities

ECTS
4 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
45h

Présentation

Objectifs

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).

Infos pratiques

Contacts

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Lieu(x)

Toulouse

Heat exchangers with or without phase transition and simultaneous heat and mass transfer

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
68h

Présentation

Description

Programme (detailed contents):

*TEMA standards, multi-tubular, plate exchangers, stirred vessels, condensers, boilers, evaporators (software Aspen HTFS), and their utilisation. Parallel, counter current, cross-flow, multi-pass heat exchanger

* Design procedure

Local and overall heat transfer coefficients, exchange area, logarithmic mean temperature difference LMTD. Pressure drop.

Efficiency. Different exchanger geometries will be considered.

*Condensation, application to the design of industrial condensers of different types of vapour mixtures.

*Boiling, evaporation, multiple effects evaporators

*Unit operations involving simultaneous mass and heat transfer: design of a cooling tower, dehumidification tower, air conditioner, extension to systems using other vapour than steam. Drying, design of dryers.

Organisation:

Lectures, tutorials and lab-work.

Objectifs

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

- the different types of heat exchangers, condenser, evaporators and other contactors carrying out both heat and mass transfer (cooling tower, humidification-dehumidification process, air conditioning systems, drying equipments,..)

- the mass and heat transfer mechanisms in these equipments

- the notion of efficiency

- film-wise and drop-wise condensation, the characteristics of the condensation of single or mixed vapours with or without incondensable compounds

- the different mechanisms of boiling

- the concept of local coefficient and overall heat transfer coefficient

- the concept of simultaneous mass/heat transfer and their application to engineering especially for handling the system Air/Water/Steam

The student will be able to:

- select the adequate technology of the heat exchanger depending on the process requirement

- establish mass and energy balances on heat exchanger (continuous or batch, with or without phase change)

- establish simultaneous mass and energy balances

- design exchangers of all type: determine the local and overall transfer coefficient, evaluate its performance and its variation with a change of operating conditions

- use software such as ASPEN HTFS to design the heat exchanger

- design unit operations involving simultaneous transfers, such as cooling tower, dehumidification tower, air conditioners, dryers.

- provide basic elements useful for the design of furnaces

Pré-requis nécessaires

Thermal transfers and reactors

Fluid properties and mass transfer

Thermodynamics

Infos pratiques

Lieu(x)

› Toulouse

Processes & energy

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
42h

Présentation

Description

Programme (detailed contents):

- the global context of production and processing energy

- processes for power generation,

- renewable energies : wind, solar and biogas,

- steam power cycles: Carnot cycle with superheat, reheat and withdrawals (cycle with maximum theoretical efficiency). Application to nuclear plants. Cogeneration systems. Size and optimization of the plant (energy and exergy efficiency)

- refrigeration cycles from reverse Carnot cycle without change of state to the real cycle of refrigerating machines with change of state.

- the absorption chillers. Size and optimization of the plant (energy and exergy efficiency)

- the gas liquefaction. Cycle at maximum theoretical efficiency, Linde and Claude cycles. Presentation facilities for liquefying air and separating components. Special facilities for hydrogen and helium.

Organisation:

Lectures, tutorials and lab work. This modules includes visiting of: a wind farm, a nuclear power plant (Golfech) and a landfill site (Montech)

Objectifs

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

- the world context of power-generating systems, which produces a net power output from a fossil, nuclear or renewable energy source.

- the legal and technical context of the various forms of renewable energy (wind, solar photovoltaic, biomass ...),

- the different thermodynamic cycles associated to the power generation systems, the refrigeration and heat pump systems and the gas liquefaction.

- the use of energy and exergy balances for these thermodynamic systems in order to optimize their operation

The student will be able to:

- design a given steam power plant, including the choice of working fluid temperatures, pressures and the determination of fluid working flows plus the pre-sizing of compressors and turbines

- design a refrigeration system, including the choice of working fluid temperatures, pressures and the determination of fluid working flows plus the preliminary design of compressors and expansion devices,

- design a gas liquefaction plant

- participate in the implementation of a wind energy area development and a site photovoltaic,

- participate in the implementation of a biogas network.

Pré-requis nécessaires

Thermodynamics.

Infos pratiques

Lieu(x)

> Toulouse

Project for research introduction

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
12h

En bref

Langue(s) d'enseignement: Français, Anglais

Présentation

Description

Program:

- the national research structures

- the principles of patent right

- how to perform a relevant literature review on a subject

- identification of a problem and scientific approach to solve it

- participation to a current research project in a laboratory

- health and safety rules in a research laboratory

Project management: definition and organization

- content (clearly define the limits and tasks)

- deadlines (with prioritization of tasks, Gantt chart)

- HR (assign tasks to people with skills, communication, team management)

- risk analysis, cost estimation.

Organization:

Conferences. Lectures and tutorials on literature survey.

Supervised research project performed in group of 3 students on current projects of the laboratory, by using the project management approach. Presentation of the project results in a poster session.

Objectifs

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

- the approach and tools for a good literature and patent survey

- how to develop a scientific work

- the health and safety rules in a research laboratory

- the basic methods for project management

- the organisation of the public research in France

- principles of patent right

The student will be able to:

- to delimit and deepen a scientific research project

- to draw an up-to-date inventory of knowledge on this topic and to identify the international leading research teams

- to propose and to experimentally perform a scientific approach to address a problem based upon the previous literature survey with respect to health and safety rules

- to share and communicate the results with a common scientific formalism (paper, poster)

- to perform a project management approach

Pré-requis nécessaires

Literature survey basic knowledge.

Project management.

Scientific knowledge in relation to the research project.

Infos pratiques

Lieu(x)

› Toulouse

Metrology Environnement and Risks

ECTS
6 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
67h

Présentation

Description

Law and Regulations in Environment

Environment Process Safety

- Dispersion of pollutants - modeling, risk assessment methods on the environment,

- Characterization and classification of wastes, waste management (treatment and storage sectors), common and radioactive wastes, environmental impact of wastes .

- Notions about the main categories of risk in Chemical Engineering: calculating probabilities of effects induced on human, toxicity, different types of explosions, thermal-runaway. Methods and devices for protection .

Metrology for Environment

- quality of measurements (accuracy, detection and quantification thresholds, robustness, repeatability, reproducibility)

- Metrology for measuring environmental impacts and / or processes design

Organisation:

Law in Environment (lectures 10h tutorials 5h)

Environment Process Safety (30h)

Environment (15h lectures / TD)

Process savety 15h including 10h lectures and 5h tutorials

Research project combining law and environmental risks (80h Estimated personal work)

Metrology for Environment (during lectures 3.75h tutorials 5h Labworks 24h)

measurement tools applied to the characterization of complex matrices or media (NTK analyzers, COD, gas, on-line UV, ionic chromatography ...). Meaning of quantities in the fields of environment and processing methods.

Quality of measurements: accuracy, reproducibility, detection and quantification thresholds. Statistical analysis of the measurements and for data calculations.

Application to the analyses of compounds in complex solutions, offline and online measurements for compounds in both liquid and gas phases, characterizations of aerobic and anaerobic biological degradation (determination of kinetic and stoichiometric parameters).

Objectifs

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

-the principles of environmental laws in France , and what tools to access legal informations

- the choice of suitable and argued measurements either for the analysis of environmental impacts or to process design

- what are the main environmental issues and principles of waste management

- the main risks in the process industry and mechanisms linked to accidents

The student will be able to:

AA1 : find and use legal informations (from legacy context) related to environmental law (ICPE , TGAP , environmental impacts, ...)

AA2 : choose and apply relevant method (s) in order to characterize the compounds and / or pollutants in complex environments or matrix doing a critical analysis of the methodology and the experimental results

AA3 : analyze a case of risk for Environment , to identify the categories of impacts, to describe pollution from the origin (=source) to the environmental targets

AA4 : analyze a situation of industrial risk, to identify and to calculate physico-chemical parameters of the involved phenomena and to propose technical solutions

Pré-requis nécessaires

The whole Chemical Engineering course.

Infos pratiques

Lieu(x)

› Toulouse

Improving autonomy and building a professional project

ECTS
4 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
39h

Présentation

Objectifs

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).

Lieu(x)

Toulouse

Infos pratiques

Communicating within organizations

ECTS
6 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
75h

Présentation

Objectifs

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.

Pré-requis nécessaires

For classes in English : mastery of general English.

Infos pratiques

Lieu(x)

Toulouse

Design and environmental assessment of processes

ECTS
9 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
47h

Présentation

Description

Programme (detailed contents):

Safe, clean and sober processes. Green chemistry and processes. Technologies associated with green processes. Scientific English. Project design: design and assessment of a plant.

Organisation:

The training will begin with lectures on green chemistry and green processes that students will have to take into account in the design project proposed afterwards. By groups of 3-4, they will develop a project from a general proposition of the teacher. They will have to: Establish a precise specification and design a full installation ; Assess the process in terms of its environmental impact, and estimate its cost.

For this, they will use their scientific knowledge but also the scientific and technical documentation in English and French. Periodical meetings with English teachers concerning their project will enable them to learn the specificities of scientific English.

Objectifs

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

- the concepts of clean, sober, safe processes, the principles of green chemistry and green processes and the associated technology choices

- particularities of scientific English

The student will be able to:

- establish a specification for a given process from a general request

- design the process, taking into account its environmental and economic aspects

- conduct an environmental assessment of the studied process

- write a scientifically supported report to explain the choices and calculations in the process design

- present the process from different points of view: scientific, environmental and economic aspects

- use the chemical engineering scientific literature in English

- make a scientific oral presentation in English about the process

Pré-requis nécessaires

All the Chemical Engineering training

Infos pratiques

Lieu(x)

- Toulouse

Human Resources Management and Group Work

ECTS
6 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
75h

Présentation

Objectifs

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

Human Resource Management

Aims and organisation of a Human Resources position, job analysis and forecasting, recruiting, work motivation, skills, salary, training, career management, conflict mitigation, work contract

Social Psychology

Groups, what they are, their influences and dynamics

The student will be able to analyse a group situation

Pré-requis nécessaires

None

Lieu(x)

Toulouse

Infos pratiques

Engineering of drinking water production and water treatment

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
86h

En bref

Langue(s) d'enseignement: Français, Anglais

Présentation

Description

Programme (detailed contents):

- fresh water resources, availability, quality and uses

- pollutions due to the conventional waste water treatment line

- regulations on potable water (national and international level) and on waste waters

- the drinking water production lines, role of unit operations and history of these lines – design of coagulation, settling, ultrafiltration, removal of iron and manganese, ozonation and chlorination steps

- the waste water treatment lines – design of an activated sludge system – sludge methanisation (digestion, treatment and valorisation of biogas) – sludge treatment : wetting and wet air oxidation)

Organisation:

Lecture-conferences, a project, tutored problems based on complex and real examples and lab-work (on a biological system for waste water treatment and on a membrane process). The project focuses on the design of a WW treatment plant in the framework of a real situation renewed each year.

Objectifs

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

- the notions of resources and uses of water, of pollutions of receiving waters

- the european and french regulations on potable water and on waster water treatment

- the main treatment lines for drinking water production and for waste water treatment and the function of unit operations in these lines

- the more recent technologies that are mainly used in these lines and the principle of their operation

The student will be able to:

- elaborate a document concerning the treatment plant definition and construction

- propose a drinking water production line (from fresh waters) and designing the main operations in this line as well as the energetic consumption

- compare different processes for waste water and sludge treatment

- design a wastewater treatment plant for the removal of major pollutants and choosing a technology for sludge treatment

- design a sludge digestion system

Pré-requis nécessaires

Hydraulics and dispersed systems

Heat transfers and real reactors

Thermodynamic properties of real fluids and mass transfer

Basic concepts for unit operations

Unit operations : technology and design

Basis on chemistry and biochemistry

Infos pratiques

Lieu(x)

› Toulouse

Rational use of energy

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
75h

Présentation

Description

Program (detailed contents):

This training will introduce the general concept of « rational use of energy ». Scientific approaches (LCA, energetic balance, exergetic balance) able to answer the requirements for an efficient use of energy will be revised and applied to energy production/consumption systems and to industrial plants. New concepts such as Pinch analysis and numerical optimization, will be developed for completing the global approach for energy-use assessment and optimization.

Organisation:

Lectures, tutorials, projects. During projects, the students will apply the different methods for energy-use assessment to energy-production and consumption systems. Dysfunctions must be identified and optimal solutions will be proposed. Students will so understand the advantages and the drawbacks of these different assessment methods.

Objectifs

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

*How to establish a life cycle analysis on energy production processes and different energy use scenarios; to use a software (Umberto) and the appropriate databases. Use of results for process eco-design.

* Pinch analysis for improving energy use in a process.

*Other optimization methods (numerical methods) depending on the case study for process ecodesign.

*Establish energy and exergy balances on energy production or energy consumption scenarios. Critical analysis of the obtained results.

*Identify dysfunctions in a system and to propose optimal solutions. To propose new scenarios considering energy aspects.

The student will be able to:

*Mobilise knowledges in chemical engineering in order to solve complex problems in the field of matter and energy processing.

*Conception, design, modelling, conducting and optimizing (for technical and economical criteria) installations in the field of chemical engineering

* Considering safety, energy efficiency and management of environmental impacts in the early step of process design and in functioning of unit processes and processes.

*Conception of new unit processes and processes in different industrial fields like Ecoindustry, Energy, Environment, in order to reduce the climate change threat and contribute to energy transition.

Pré-requis nécessaires

Energetic thermodynamics

Process simulation and assessment

Processes and energy

Heat transfer : unit operations and simultaneous heat and mass transfer

Infos pratiques

Lieu(x)

> Toulouse

Waste treatment and valorization

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
76h

Présentation

Description

Programme (detailed contents):

French and European legal definition of waste. Strategies for wastes elimination (source reduction, valorisation and treatment). Legal policies.

Air pollution control.

Treatment and valorisation of industrial and urban solids wastes. Energy valorization and material recovery.

Introduction to soil pollution and soil risk assessment. Soil treatment processes.

Organisation:

This training is organised as an active learning. Different activities with a common interest (a specific industrial activity) will allow students to approach various aspects of the waste treatment problem. Specific lectures will be proposed, including conferences of industrial partners.

Objectifs

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

- the legal and usual definitions of wastes in France. Waste characterisation

- the strategies for waste control

- the principles of unit operations and processes commonly used in waste (gas effluent, wastewater and solids waste) reduction, treatment or valorisation (chemical, biochemical and thermal processes).

- the principles of the French methodology for polluted soils risk assessment, the basis of soil treatment processes.

The student will be able to:

- identify basic rules and policies for an environmental problem, and use it to define a technical problem or to propose an adapted solution

- quantify the dispersion of air pollutants from industrial sources

- determine the valorisation potential for an industrial waste (or gas effluent or wastewater)

- select and design processes for air pollution control and for the treatment or valorisation of industrial water and solid wastes

- understand the risk assessment report of a site

Pré-requis nécessaires

All the basic Chemical Engineering courses

Physical, chemical, biological and mathematical fundamentals

Metrology, environment and risks

Infos pratiques

Lieu(x)

> Toulouse

Separation processes for specific quality water production and new resource exploitation

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
51h

Présentation

Description

Programme (detailed contents):

1 New resources for human, agricultural or industrial use

Sea water /brine Waters

Secondary effluents

Nitrogen, Phosphorus

(bio) products from wastewaters

2 Processes for specific quality water production

Reuse

Desalination

Water for process (conditioning)

1. Recycling (water in the process)

1. Design of unit operations

- ion exchange, chromatography, adsorption/ desorption

- Reverse osmosis, electrodialysis

- decarbonation,precipitation, crystallization

Organisation:

L/T/Lab work/project

Objectifs

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

- to know the context of the new resources for water and compounds of interest (sea/brine waters, secondary effluent, food bio products)

- To know specific processes for water production (desalination, reuse, ultrapure water, water for industrial use ..)

- principle and design of sorption unit operations (ion exchange, preparative chromatography, adsorption)

- principle and design of advanced membrane separation operations (reverse osmosis, electromembrane processes)

- principle and design of unit operations based on a phase transition (precipitation, crystallization,...)

The student will be able to:

- to design processes for domestic wastewaters tertiary reuse

- to design desalination processes

- to design design processes for ultrapure water production or specific water for utilities

- identify new resources

- conceive and design systems for these new resource use

- apply the knowledge to other case studies

Pré-requis nécessaires

Basic concepts for unit operations

Technology and design of unit operations

Heat transfer and reactors

Basis of chemistry

Infos pratiques

Lieu(x)

› Toulouse

Process control & optimization

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
75h

Présentation

Description

Programme (detailed contents):

* Process control and regulation (classical control, advanced control)
* Modelling and simulation of dynamic systems
* Single-objective optimization
* Applied optimization (multi-objective, evolutionary algorithms, advanced optimization)

Organisation:

* Big pictures + Jigsaw
* Lectures
* Tutorials
* Project

During the project, the following tasks will be pursued:

* WWTP Modelling via Matlab
* WWTP single-objective optimization via Golden number method
* Regulation of WWTP in the dynamic regime via Simulink
* A serious game on process control
* Optimization of coupled WWTP-cogeneration (renewable energy production)

All above-mentioned items are provided in English. I5PECS11 is an English training unit (EMINSA project 2016).

Objectifs

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

1. how to proceed for the simulation and regulation of dynamic systems via:

a) An open programming platform (Matlab)

b) A multi-domain dynamic system analyzer (Simulink)

2. how to formulate and solve an optimization problem (single-objective or multi-objective) through suited methods (derivative-based or evolutionary)

The student will be able to:

3. compare different methods for the regulation and optimization of a dynamic industrial case study (Waste Water Treatment Plant – WWTP)

Pré-requis nécessaires

Analysis and computing

Modelling and numerical solution for fluid mechanics

Heterogeneous reactor engineering

The whole chemical engineering course

Infos pratiques

Lieu(x)

> Toulouse

Reactor Design & Flow Assurance

ECTS
5 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
52h

Présentation

Description

Program (detailed contents):

Development of conservation equations for mass, momentum, species transport and energy by phase-averaging to describe locally multiphase systems.

Establishment and modelling of 3D, 2D, 1D and 0D multiphase systems.

Flow regimes in multiphase system (bubble column, airlift, gas-liquid transport, liquid-liquid flows...)

Closure relations (isolated, diluted, dense swarm), coupling and interactions between entities (population balance and exchange term).

Deep use of existing simulation tool in function of the physical scales, limited phenomena and coupling effects (Excel, Matlab, Ansys, Comsol). Tools benchmarking.

Organisation:

* Face to face lectures

* Academic and tutorials exercises of engineering (agitated and aerated tank, ozonation tower, airlift bioreactor, crystallisation column, multiphase transport in pipe and micro-reactor, liquid-liquid settler...). Cookbooks with recipes and tutorials.

* Industrial and numerical work project with partnership and evolving in an engineer training period. Serious games on a virtual industrial reactor.

* Practical works on instrumented pilot scale (multiphase process with coupling: oxidation in an airlift, agitated tank...)

* Invited conferences of industrial partners

Objectifs

Programme (detailed contents):

* Process control and regulation (classical control, advanced control)
* Modelling and simulation of dynamic systems
* Single-objective optimization
* Applied optimization (multi-objective, evolutionary algorithms, advanced optimization)

Organisation:

* Big pictures + Jigsaw
* Lectures
* Tutorials
* Project

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All above-mentioned items are provided in English. I5PECS11 is an English training unit (EMINSA project 2016).

Pré-requis nécessaires

Modelling and numerical solution for fluid mechanics

Thermal transfer and reactors

Basic concepts for OPU

Technology and design of OPU

Processes simulation and analysis

Infos pratiques

Lieu(x)

› Toulouse

Training period (4th year)

ECTS
9 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
1h

En bref

Langue(s) d'enseignement: Français, Anglais

Infos pratiques

Lieu(x)

Toulouse

Training period (5th year)

ECTS
21 crédits

Composante
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Volume horaire
2h

En bref

Langue(s) d'enseignement: Français, Anglais

Infos pratiques

Lieu(x)

Toulouse