

3rd YEAR ICBE GPE SPECIALITY SEMESTER 5

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

Fluid mechanics

Introducing

Description

From the complete Navier Stokes model, we develop the usual restricted models of incompressible flows such as: Stokes (creeping flow), Euler (inertial flow without viscosity), Prandtl (laminar boundary layer) and Reynolds (turbulent flow). We describe and apply the following usual basics of fluid mechanics: Euler's theorem, Bernoulli's theorem, perfect fluid, irrotational flow, fluid wall interaction (dynamic and thermal boundary layer), drag coefficient. Turbulence is studied through the notion of turbulent viscosity, the universal logarithmic law profile, the k-epsilon model and the different scales of turbulence.

Objectives

To learn the basics of fluid mechanics modeling in order to understand the operation and to size the laboratory devices and the industrial installations involving flows.

1. To understand and apply global mass and momentum balances on a control domain
1. To understand the mechanical energy balance and apply Bernoulli's theorem
2. To master the concepts of dynamic and thermal boundary layers and use the associated transfer coefficients
3. To write a force balance on an inclusion by choosing the appropriate drag law

4. To write and to use the universal velocity profile in turbulent flow

5. To estimate the characteristic spatial and temporal scales of turbulence in reactors

Necessary prerequisites

I2BEMT10 : Mathématiques

I2BEBT10 : Bases de transfert

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Physical chemistry

Introducing

Description

The program includes:

Definitions and properties of interfaces (liquid-gas, liquid-liquid, solid-liquid).

Measurement and role of surface tensions.

Capillarity and related laws (Jurin, Young-Laplace).

Wettability and contact angle.

Adhesion work and Young-Dupré laws.

Surfactants: structure, classification, micelles, applications.

Intermolecular and colloidal forces (Van der Waals, electrostatic, hydrophobic).

Colloidal stabilization/destabilization (DLVO theory, polymers, flocculation).

Applications: emulsions, foams, detergents.

Basic knowledge of molecular kinetics and intermolecular interactions.

General understanding of solution chemistry (solubility, polarity, pH).

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Practical info

Location(s)

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Objectives

The course aims to provide an understanding of the physical chemistry of surfaces and colloids: surface tension and energy, capillarity, wettability, adhesion, the role of surfactants, molecular interactions, and applications to colloids, emulsions, foams, and detergents.

Necessary prerequisites

Fundamentals of thermodynamics and physical chemistry.

Dispersed systems

Introducing

Description

- Basic concepts:
 - Motion of particles, drops and bubbles in a fluid (various separation regimes, spherical and non spherical particles, concentrated media)
 - fluid flow through a porous media (pressure drop, resistance)
 - hydrodynamics of packed towers
- Unit operations:
 - cake filtration
 - sedimentation
 - fluidisation
- Dimensional analysis

Objectives

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

- basic concepts of unit operations associated with momentum transfer phenomena for dispersed systems (bubbles, drops, particles)
- basic concepts of fluid flow through a porous medium
- principle of dimensional analysis
- mass and energy balance

The student will be able to apply these concepts:

- to the design of different unit operations: sedimentation, filtration
- to the calculation of hydrodynamics of a packed tower, of a fluidised bed

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Heat Transfer

Introducing

Description

Common Section :

The student should be able, for plan, cylindrical, and spherical systems in steady-state conditions, with or without heat generation, to:

- Establish and solve the energy balance equations in steady-state conditions to calculate heat fluxes and characterize temperature gradients,
- Calculate heat fluxes, thicknesses of materials composing walls, pipes, spherical tanks in steady-state conditions,
- Calculate temperatures at interfaces.

Section GP3E:

The student should be able to:

- Explain the different heat fluxes
- Establish energy balances on reactive or non-reactive systems
- Integrate differential equations to determine temperature profiles and assess heat fluxes
- Know how to transmit a given amount of heat between two systems
- Know how to limit heat losses through a surface
- Study cases applicable to processes.

Section GB:

The student should be able to:

- Choose a technology and configuration of heat exchanger according to its uses
- Calculate heat exchange between fluids within a heat exchanger based on steady-state configurations
- Calculate the efficiency of a heat exchanger based on steady-state configurations
- Size the heat exchange surface of a heat exchanger

according to its steady-state configuration

- Calculate the performance of heat exchangers based on flow rates and inlet and outlet temperatures of fluids
- Solve, in transitional regime, the energy balance equations on a perfectly stirred tank to calculate heating and cooling times according to the implemented technologies (coil, double-wall, external heat exchanger) with or without thermal loss

Objectives

Common Section :

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

- The general equation of energy conservation,
- The different modes of heat transfer and the associated laws into the phenomena of conduction (Fourier's law) and forced and natural convection (Newton's law),
- The expressions for heat flux by conduction and convection and temperature profiles within different systems in steady-state conditions (simple and composite walls, cylindrical and spherical layers, simple and composite).

Section GP3E:

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

- Heat transfer in solids with and without heat production in steady-state
- Heat transfer in solids with and without heat production in transitional regime
- Heat transfer by radiation

Section GB:

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

- Different technologies of heat exchangers (tubular, plate, coil, double-wall) implemented industrially
- Principles and operating theories of heat exchangers
- Sizing of heat exchangers

Necessary prerequisites

- Thermodynamics
- Differential Equations and Partial Differential Equations

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Location(s)

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Hydraulic engineering



ECTS



Hourly volume
39h

Introducing

Description

Macroscopic mass, momentum and energy balances
Fluid rheology
application of energy balances (Bernoulli) ducted and free flows
Linear and singular pressure losses
Turbomachinery: Pumps and turbines
Hydraulic networks
Extension to total energy balance (EC thermodynamics)

Objectives

dimension a complete plant (processes, plants, hydropower turbine) from the hydraulic point of view

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Processes

Introducing

Description

Introduction to the concept of process, the way of building it, constraints of the industrial production. Representation and estimate of the cost of a process. Description of some large production channels. Critical analysis of a transformation channel of matter or energy, through a project in group.

Objectives

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

- the principle of raw materials transformation processes (oil, coal, gas, ore, biomass), of organic and mineral heavy chemistry (refining, petrochemistry, NH_3 , H_2SO_4 , Na_2CO_3 , NaOH , Cl_2 , manure...) and of energy production (thermal, nuclear, biomass)
- the principle of the diagrammatic representation of a process (flowsheet) and associated graphics
- the principles of cost estimation of a process
- the industrial context of the sector

The student will be able to:

- describe a production system
- 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
- estimate the cost of a process
- know to work in autonomy starting from a schedule of conditions to find and analyze scientific documentation.

Necessary prerequisites

Mineral and organic chemistry, biochemistry
Thermodynamics
Chemical kinetics, reactors
Unit operations of chemical engineering
Regulation
Metrology

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Ecological Transition, GHG Reduction, Responsibility and Environment (EARTH)

Introducing

Description

The teaching includes a "2 tonnes" workshop, which provides a fun way of understanding the orders of magnitude linked to the objectives of carbon neutrality in 2050. It also includes assignments on the following topics: housing; electricity production; inequalities and responsibilities; mobility; the climate inaction debate; agriculture and food; and aeronautics. Students also work on a complex problem linked to ecological issues, starting their reflections from an everyday object or service.

Objectives

At the end of this module, the student will be able to:

- ✕ Be comfortable with the fundamental concepts related to greenhouse gas emissions, and be able to make simple calculations on this subject.
- ✕ Know the order of magnitude of important quantities.
- ✕ Be able to fetch emission values from the ADEME database and use them appropriately.
- ✕ Think about ecological issues in all their complexity and study a specific problem
- ✕ Have an understanding of life cycle analysis and how to apply it
- ✕ Be able to research scientific literature

- ✕ Be able to understand and analyse figures/data
- ✕ Draw political conclusions from scientific facts and one's own values
- ✕ Debate, discuss and confront points of view.

Necessary prerequisites

Basic knowledge on energy.

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Job Hunting Techniques

Introducing

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Job search

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Humanities elective course

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Physical Education

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