Chemistry - Process Engineering

ECTS credits
5 credits

In brief

Course langage: French

Presentation

Learning objectives

In chemistry:
- know the general principles of chemical kinetics and thermodynamics as well as structure-property relationships of molecules
- Know the reactive molecular entities
- Know the general concepts of organic reactivity

In process engineering:
- Know how to apply material and energy balances, with and without chemical reaction, in steady state on a on a system
- Know and know how to calculate the volume of ideal reactors (closed reactor, perfectly agitated, piston) in simple cases.
- In the case of perfectly stirred reactors, know how to calculate the adiabatic temperature
- To approach the transient regime
- Apply this knowledge to the distillation of a binary mixture
- Know the thermodynamics of liquid/vapor equilibrium
- Know how to dimension a tray rectification column in continuous and batch modes.

Description of the programme

In Chemistry:
Molecular Structure:
1. Chemical element and atom - Electronic configurations - Lewis theory - Geometry of molecules
Molecules - Quantum model of the atom - Molecular orbitals - Hückel's method

2. Formal chemical kinetics - Speed and order of reaction and rate constant - Kinetics of complex reactions (parallel, consecutive reactions) - Mechanics - Activation thermodynamics Thermodynamics of activation - Kinetic/thermodynamic control
3. Chemical thermodynamics - Standard state - State functions First principle and applications - The chemical potential - Second principle and evolution of chemical systems Second principle and evolution of chemical systems

Organic reactivity :
1. Static stereochemistry (central and axial chirality) - Dynamic stereochemistry (conformational analysis)
2. Reactivity of alkanes and halogeno-alkanes, reactive species - Nucleophilic substitution - Elimination
3. Kinetic control, thermodynamic control - orbital control, charge control, steric control

In Process Engineering:
1. Balances and reactor:
- Introduction to process engineering and unit operations
- Global analysis of a manufacturing process
- Application of global and partial balances without chemical reaction
- Application of global and partial balances with chemical reaction
- Energy balance, with and without chemical reaction
- Introduction to reactors (process & technology aspects)
- Particular case of ideal reactors

2. Distillation of a binary mixture :
- Introduction to separative methods
- Thermodynamics of liquid/vapour equilibrium
- Flash distillation
- Rectification in continuous mode: sizing by the Mac Cabe and Thiele method
- Rectification in batch mode : Rayleigh equation and sizing.

Generic central skills and knowledge targeted in the discipline

In Chemistry:
- Be able to understand the kinetics and thermodynamics of molecular transformations
- Know how to identify the reactive species of a chemical system, know how to formulate hypotheses for a reaction mechanism
- Predict the selectivity and stereochemistry of a molecular transformation.

How knowledge is tested

DS Chimie (2/3) - GP (1/3) : 50 %
CC (TD + TP + TA) Chimie (2/3) - (TD + TA) GP (1/3) : 50 %

Bibliography

Online resources on the Ecole Centrale pedagogical portal
Books (documentation center)

Teaching team

Chimie :

* Bastien Chatelet
* Laurent Giordano
* Alexandre Martinez
* Didier Nuel
* Innocenzo De Riggi
* Anne-Doriane Manick
* Cédric Colomban
* Louise Miton
* Emile Vandeputte

Génie des procédés :

* Pierrette Guichardon
* Pascal Denis
* Nelson Ibaseta
* René Arnaud

Sustainable Development Goal

Responsible consumption and production

Total des heures		**96h**
CM	Master class	36h
TD	Directed work	32h
TP	Practical work	4h
AA		24h

Useful info

Name responsible for EU

Lead Instructor
Alexandre Martinez
alexandre.martinez@centrale-marseille.fr