Université de Toulouse

Faculté sciences et ingénierie Université de Toulouse

PÉRIODE D'ACCRÉDITATION : 2022 / 2026

UNIVERSITE DE TOULOUSE

SYLLABUS MASTER

Mention Chimie

Master Chimie parcours Chimie Verte

http://www.fsi.univ-tlse3.fr/
https://www.univ-tlse3.fr/master-mention-chimie

2026 / 2027

20 NOVEMBRE 2026

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PRESENTATION OF DISCIPLINE AND SPECIALTY

DISCIPLINE CHIMIE

The master in chemistry offers four specialties : green chemistry, analytical chemistry, chemistry for health, theoretical chemistry and also offers training towards careers in teaching.
The objective is to train students into chemists executives for academic positions or positions in companies covering various business sectors such as the pharmaceutical, cosmetics, chemicals and food industry, materials and instrumentation.
The training also helps develop important transversal skills for employability such as : autonomy, communication, project management, ...
The master in chemistry proposes a progressive orientation in the chosen specialty.
The first year includes a significant share of core courses and specific courses in the chosen specialty.
The second year is rather strongly focused on the specialty.
Internships are included in the training (minimum 8 weeks in M1, 5 to 6 months in M2).

SPECIALITY

The aim of the Green Chemistry Master's course is to provide students with the necessary skills to innovate towards more sustainable chemistry. With this training, students will be able to devise and develop cleaner and safer processes, more respectful of the environment, particularly in the fields of alternative reaction media, catalysis, green processes, depollution, biodegradable materials design, alternative energy sources, biomass valorization. Aspects of regulation, legislation, toxicity, ecotoxicity, life cycles and project management will be dealt with.
The M2 program is taught entirely in English.
The co-accreditation of this master with the INP (ensiacet) implies the mutualization of teaching units, proposed by the 2 establishments.

PRESENTATION OF THE YEAR OF MASTER CHIMIE PARCOURS CHIMIE VERTE

The second year of the green chemistry Master's is divided into 2 semesters :
-First semester (from September to December) : the theoretical teaching takes place in the form of traditional courses and tutorials as well as projects. These courses are given on 2 sites, the UPS and the INP. The first exam session takes place in December.
- semester 2 : Starting in January and until June, the students will carry out a full time, research-based internship, counting towards 30 ECTS. The internship topic must match the preoccupations of green chemistry.
The 5-6 months internship will be most students' first interaction with real world R&D. It can be done in an academic or industrial laboratory , in France or abroad. The internship will be finalised with a written report and an oral presentation.

STUDY ARRANGEMENTS

The Master 2 Green Chemistry course is also open to work-study. Interested students must find the company/public organization with which they will do their work-study. The calendar is designed to make it possible to do a work-study program with a company located outside Occitania.

LIST OF RECOMMENDED COURSES :

L SdV3 PPE

CONTACTS SECTION

CONTACT INFORMATION CONCERNING THE SPECIALTY

PERSON IN CHARGE OF TEACHING AFFAIRS OF MASTER CHIMIE PARCOURS CHIMIE VERTE

BEDOS Florence
Email : florence.bedos@univ-tlse3.fr Téléphone : 68.00

DE VIGUERIE Nancy
Email : nancy.de-viguerie@univ-tlse3.fr Téléphone : 0561556135

EVRARD David
Email : david.evrard@utoulouse.fr Téléphone : 05 61 55 60 73

SORTAIS Jean-Baptiste
Email : jean-baptiste.sortais@lcc-toulouse.fr

SECRETARY OF STUDENT AFFAIRS OF

BOURREL Céline
Email : celine.bourrel@univ-tlse3.fr Téléphone : 05.61.55.65.37

Université Paul Sabatier
U3 1er étage porte 113
118 route de Narbonne
31062 TOULOUSE cedex 9

CONTACT INFORMATION CONCERNING THE DISCIPLINE

PERSON IN CHARGE OF THE DISCIPLINE CHIMIE

SORTAIS Jean-Baptiste
Email : jean-baptiste.sortais@lcc-toulouse.fr

CONTACT INFORMATION FOR THE DEPARTMENT : FSI.CHIMIE

HEAD OF DEPARTMENT

CUNY Jérome
Email : jerome.cuny@utoulouse.fr Téléphone : 05 61 55 68 36

DEPARTMENT SECRETARY

CASTAING Juliette
Email : juliette.castaing@utoulouse.fr

TABLE SUMMARIZING THE MODULES THAT MAKE UP THE TRAINING PROGRAM

page	Code	Title of the module	semestre*	ECTS	Mandatory Optional	Cours	TD	Projet	Stage*
First semester									
14	KCHV9ABU	LANGUE VIVANTE	I	3	O		24		
13	KCHV9AAU	PROFESSIONNALISATION	I	6	O	30	30		
15	KCHV9ACU	MOLECULAR CATALYSIS (Molcat)	I	3	O	20	15		
16	KCHV9ADU	SURFACE CATALYSIS	I	3	O	20	15		
17	KCHV9AEU	FURTHER ADVANCES IN ORGANIC SYNTHESIS (orgasyn)	I	3	O	30			
	KCHV9AFU	TOXICOLOGY/ECOTOXICOLOGY	I	3	O				
18	KBSX9AB2	Ecotoxicologie 2					24		
19	KCHV9AF1	Toxicology/ecotoxicology (toxicology/ecotoxicology)				16			
20	KCHV9AGU	CHEMISTRY FOR ALTERNATIVE ENERGIES	I	3	O	30			
21	KCHV9AIU	PROJECT (project)	I	3	O	10		50	
22	KCHV9AJU	ADVANCED HETEROCHEMISTRY AND STEROSELECTIVE SYNTHESIS (HETSYN)	I	3	O	20	15		
12	K5CHX01C	PROFESSIONNALISATION (MUTUALISÉE POUR TOUS LES PARCOURS)	I	0	F	30	30		
Second semester									
23	KCHVAAAU	STAGE (internship)	II	30	O				6

* **AN** :year long teaching, **I** : first semester, **II** : second semester

***Stage**: in number of months

LIST OF THE MODULES

UE	CLEAN ROOM SESSION 1 (AIME-GS)	3 ECTS	
KCHV0FAU	TP : 20h	Teaching in anglais	Personal work 75 h

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UE	CLEAN ROOM SESSION 2 (AIME-uF)	3 ECTS	
KCHV0FBU	TP : 20h	Teaching in anglais	Personal work 55 h

[Retour liste des UE]

UE	NANOX CORE COURSE 1 (NCat)	3 ECTS	
KCHV0FCU	Cours : 15h , TP : 25h	Teaching in anglais	Personal work 75 h

[Retour liste des UE]

UE	NANOX CORE COURSE 2 (Carac)	3 ECTS	
KCHV0FDU	Cours : 15h , TP : 25h	Teaching in anglais	Personal work 35 h

[Retour liste des UE]

UE	PROFESSIONNALISATION (MUTUALISÉE POUR TOUS LES PARCOURS)	ECTS	1st semester
K5CHX01C	Cours : 30h , TD : 30h	Teaching in anglais	Personal work 60 h

[Retour liste des UE]

UE	PROFESSIONNALISATION	6 ECTS	1st semester
KCHV9AAU	Cours : 30h , TD : 30h	Teaching in anglais	Personal work 90 h

[Retour liste des UE]

TEACHER IN CHARGE OF THE MODULE

BEDOS Florence
Email : florence.bedos@univ-tlse3.fr

LEARNING GOALS

To prepare the student for professional integration through a better knowledge of the socio-economic environment in the field of chemistry and the expectations of companies.

SUMMARY OF THE CONTENT

This interactive course is based on the participation and involvement of students in different workshops such as :

1. Reflection on the video CV/ interview preparation
2. Various lectures dealing with, for example, ethics in research, intellectual property, business creation, quality approach, team management.....
3. Interviews with researchers
4. Lectures given by visiting professors to open up research at national and international level.

PREREQUISITES

none

SPECIFICITIES

UE common to the whole of the Master 2 Chemistry course

TARGETED SKILLS

To prepare a successful professional integration.

KEYWORDS

Management, patent, company creation, professional integration

UE	LANGUE VIVANTE	3 ECTS	1st semester
KCHV9ABU	TD : 24h	Teaching in anglais	Personal work 51 h

[Retour liste des UE]

TEACHER IN CHARGE OF THE MODULE

CHAPLIER Claire
Email : claire.chaplier@univ-tlse3.fr

LEARNING GOALS

Level C1 of the CEFRL (Common European Framework of Reference for Languages) - Develop the skills necessary to students to succeed in their future professional lives in a variety of cultural contexts.- Acquire the necessary linguistic autonomy and improve the specialized language allowing professional integration and communication of scientific expertise in an international context.

SUMMARY OF THE CONTENT

- Develop skills related to the understanding of scientific or professional publications written in English as well as skills necessary to understand oral scientific communications.
- Acquire expression tools in order to master an oral and/or written presentation and to tackle a critical discussion in the scientific field, (e.g. rhetoric, linguistic elements, pronunciation...) .
- Acquire the linguistic and cultural elements of professional communication (CV, cover letter, interview)

PREREQUISITES

Level B2 CEFRL

SPECIFICITIES

Assessment methodology : Continuous assessment

TARGETED SKILLS

Speak fluently in front of an audience, using registers adapted to different contexts and different interlocutors.
Use a foreign language other than French easily : written and oral comprehension and expression :
- Understand a scientific or professional article written in English on a subject related to their field.
-Interact orally in English in order to succeed in formal and informal exchanges during lectures, meetings or professional interviews.- Defend your application in writing (CV) or orally (job interview) in English

KEYWORDS

Project - Scientific English - Writing - Publishing - Communications - Interculturality - professionalisation.

UE	MOLECULAR CATALYSIS (Molcat)	3 ECTS	1st semester
KCHV9ACU	Cours : 20h , TD : 15h	Teaching in anglais	Personal work 40 h
URL	https://moodle.univ-tlse3.fr/course/view.php?id=6679		

[Retour liste des UE]

TEACHER IN CHARGE OF THE MODULE

GRELLIER Mary
Email : grellier@lcc-toulouse.fr

LEARNING GOALS

Increase and expand the knowledge of students in eco-friendly chemistry with integration of the catalysis concepts for homogeneous, supported, bio catalysis. Different possible industrial applications will be presented.

SUMMARY OF THE CONTENT

I-Introduction .
II-Catalysis and molecular reactivity.
A) Homogeneous Organometallic Catalysis :
Activation of small molecules (H2, CO, CO2, NH3, alkenes, alkynes), oligomerization. Mechanisms of catalytic reactions and significant processes. C-H activation, hydroformylation, hydroamination, isomerisation, organometallic compounds involving 2 electrons -3 center bonds
B) Biocatalysis :
Principle and operation of biological systems (enzymes, cells) involved in organic synthesis reactions
C) Interfacial catalysis
Interfacial catalysis to perform a catalytic reaction in nano- or micro-heterogeneous media relying on the dispersion type (i.e., biphasic systems, micelles, microemulsions, and emulsions), the nature of the surface active or phase-transfer agent, and location of the catalyst in the Liquid-Liquid system.
III) Applications
Applications : Øfrom molecular catalysis to supported catalysis and interfacial catalysisØ (parts A/B/C) will be illustrated trough publications. The sessions will be interactive and collaborative work of the students.

PREREQUISITES

Organic and organometallic chemistry of the Master 1's level - Basic knowledge of kinetic and thermodynamic chemistry of the L3's level.

SPECIFICITIES

Language : English
Some of the courses will be given in the form of videos associated with personal work in autonomy with return.

TARGETED SKILLS

Design and implement molecular catalysts in a sustainable development context for applications using the activation of small molecules

REFERENCES

G. J. Kubas ; Metal Dihydrogen and =11.0pts=11.0pt-bond Complexes, **2013** Ed =11.0ptSpringer-Verlag New York Inc.

KEYWORDS

Catalysis, catalytic cycle, mechanism, selectivity, atom-economy, saving steps, recycling, hydrogen

UE	SURFACE CATALYSIS	3 ECTS	1st semester
KCHV9ADU	Cours : 20h , TD : 15h	Teaching in anglais	Personal work 40 h

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TEACHER IN CHARGE OF THE MODULE

SERP Philippe
Email : philippe.serp@ensiacet.fr

LEARNING GOALS

This course by presenting not only the basic concepts of catalysis but also, right from the beginning, integrating the chemical, materials and engineering aspects of catalysis in examples taken directly from industry should provide an understanding of the underlying connections between the chemical, materials and engineering aspects of surface catalysis.

SUMMARY OF THE CONTENT

1. Introduction to heterogeneous catalysis Basic concepts of heterogeneous catalysis - thermodynamics and kinetics. Basic phenomena of heterogeneous catalysis - chemical and physical phenomena. Mechanisms of heterogeneous catalytic reactions. Types of catalysts and catalysis (thermal-, photo- and electro-catalysis).
2. Heterogeneous catalysis Reactivity descriptors (d-band center theory), catalysts preparation and characterization, catalyst deactivation, challenges in the development of new materials and catalytic technologies.
3. Nanocatalysis Main nanoparticles (NPs) preparation methods ; immobilization of NPs in solid and liquid phase. Main properties associated with reactivity. Mechanistic approaches : molecular reactivity versus surface reactivity. Applications in catalysis : supported metallic NPs (hydrogenation) ; metallic NPs in ionic liquids (couplings) ; metallic NPs of abundant metals (hydrogenations, multi-component reactions)
4. Catalytical reactors and processes Operating regimes of heterogeneous catalysts. Coupling heterogeneous reaction and internal and external transport phenomena. Introduction to heterogeneous reactor technologies and type of reactor selection criteria.

PREREQUISITES

The students should have a basic knowledge of General and Inorganic Chemistry, Organic Chemistry, Physical Chemistry and Chemical Thermodynamics and Kinetics.

SPECIFICITIES

The lessons will be in English.
Exam : 1 written exam in 2 parts (part 1. Heterogeneous catalysis, which will include a question on reactors ; part 2. Nanocatalysis)

TARGETED SKILLS

At the end of the course, the student is able to :
- Describe the main methods of synthesis of supports and their shaping
- Describe and select the different methods for the preparation of heterogeneous catalysts and their activation.
- Design and synthesize catalytic materials
- Implement catalytic alternatives in a sustainable chemistry approach.

REFERENCES

Principles and Practice of Heterogeneous Catalysis, 2nd Edition, John Meurig Thomas, W. John Thomas Eds. Wiley, Weinheim, 2015. ISBN : 978-3-527-31458-4

KEYWORDS

Solid catalysts, supported catalysts, colloidal nanoparticles, surface reactivity, surface chemistry, surface characterization, catalytic reactors

UE	FURTHER ADVANCES IN ORGANIC SYNTHESIS (orgasyn)	3 ECTS	1st semester
KCHV9AEU	Cours : 30h	Teaching in anglais	Personal work 45 h
URL	https://moodle.univ-tlse3.fr/course/view.php?id=3097		

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TEACHER IN CHARGE OF THE MODULE

GUILLEN Frédéric
Email : frederic.guillen@utoulouse.fr

LEARNING GOALS

To improve & broaden the knowledge of students in organic synthesis, with particular emphasis on the selective construction of molecular architectures within the Green Chemistry context. Noteworthy is that this teaching unit is in logic continuation of the notions & concepts developed in two teaching units of the M1 CHIMIE, *ie.* ØOutils et Stratégies de Synthèse' and ØMilieux Réactionnels et Méthodes d'Activation Alternatifs'.

SUMMARY OF THE CONTENT

1. *Tools & strategies for organic synthesis I* - alternative methods for functional group interconversion (focus on oxidation/reduction reactions) and for the formation of a single C-C bond (aldol-type reactions) - principles of asymmetric synthesis will be dealt with in this part.
2. *Tools & strategies for organic synthesis II* - methods for the one-pot formation of several bonds (multicomponent reactions, domino/tandem reactions).
3. *Recent applications* - applications in the construction of complex molecular architectures and in total synthesis (cases studies with a further focus on protecting group-free chemistry, biomimetic chemistry, biomass, and chiral pool).

PREREQUISITES

Organic Chemistry & Organometallic Chemistry at the Master 1's level - Knowledge of Green Chemistry principles & familiarity with the related metrics.

SPECIFICITIES

courses in english

TARGETED SKILLS

— choose the appropriate tool to implement a chemical transformation involving the stereoselective formation of a C-C bond using the green chemistry principles, including atom and/or step economy, the use of catalytic methods and/or less harmful reagents.
— choose the appropriate tool to implement a chemical transformation involving one-pot formation of multiple C-C bonds using the green chemistry principles, including atom and/or step economy, the use of catalytic methods and/or less harmful reagents.
— (et éventuellement : design and implement syntheses in a context of sustainable development)

REFERENCES

JE Bäckvall - *Modern Oxidation Methods* , **2010** (WILEY-VCH)
L Tietze & al. - *Domino Reactions in Organic Synthesis* , **2006** (WILEY-VCH)
J Zhu & al. - *Multicomponent Reactions in Organic Synthesis* , **2014** (WILEY-VCH)

KEYWORDS

alternative oxidation/reduction methods - asymmetric synthesis - multicomponent reactions - domino/tandem reactions

UE	TOXICOLOGY/ECOTOXICOLOGY	3 ECTS	1st semester
Sous UE	Ecotoxicologie 2		
KBSX9AB2	TD : 24h	Teaching in anglais	Personal work 35 h

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TEACHER IN CHARGE OF THE MODULE

GAUTHIER Laury
Email : laury.gauthier@univ-tlse3.fr

LEARNING GOALS

The objective is to make the student aware of the problems linked to the chemical contamination of biological systems and to teach him/her to use analytical chemistry, toxicological and ecotoxicological data with a view to the effective management of short, medium and long term crisis situations.

SUMMARY OF THE CONTENT

The Environmental Risk Assessment (ERA) approach is presented as well as the principles of using ecotoxicological data in the existing regulatory frameworks at both national and international levels. The methods will be discussed in the course of a case study constituting a situation very close to reality.

PREREQUISITES

Knowledge of green/sustainable chemistry issues

SPECIFICITIES

This training course uses the complementary knowledge of groups of students from different disciplinary backgrounds (Chemistry & Biology/Toxicology) who learn to work together to provide technical solutions to the problems posed.

TARGETED SKILLS

-Identify the risk situations according to the environmental context
-To pose a diagnosis for sustainable solutions to be brought to the problem
-Evaluate the consequences and regulatory implications of a contamination situation

REFERENCES

Ecotoxicologie, Cours, Applications, coll. Sciences Sup, DUNOD Ed.

KEYWORDS

Toxicity ; Ecotoxicity ; Environmental Risk Assessment

UE	TOXICOLOGY/ECOTOXICOLOGY	3 ECTS	1st semester
Sous UE	Toxicology/ecotoxicology (toxicology/ecotoxicology)		
KCHV9AF1	Cours : 16h	Teaching in anglais	Personal work 35 h

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TEACHER IN CHARGE OF THE MODULE

GAUTHIER Laury
Email : laury.gauthier@univ-tlse3.fr

LEARNING GOALS

The objective is to make the student aware of the problems linked to the chemical contamination of biological systems and to teach him/her to use analytical chemistry, toxicological and ecotoxicological data with a view to the effective management of short, medium and long term crisis situations.

SUMMARY OF THE CONTENT

The different forms of toxicity are presented as well as their levels of expression on the scale of the molecule, the individual (toxicology) and the ecosystem (ecotoxicology). The consequences of chemical contamination will be examined in terms of their impact on living systems at the different scales of perception of the environment. The student will apprehend all the contexts to be considered through a case study in a real contamination situation.

PREREQUISITES

Knowledge of green/sustainable chemistry issues

SPECIFICITIES

This course requires internet acces for students

TARGETED SKILLS

-Identify the risk situations according to the environmental context
-To pose a diagnosis for sustainable solutions to be brought to the problem
-Evaluate the consequences and regulatory implications of a contamination situation

REFERENCES

Essentials of Toxicology, Casarett & Doulls, Mc Graw Hill edt, 3rd Edition
Chimie et environnement, P. Behra et al., Sciences Sup, Dunod edt

KEYWORDS

Toxicity ; Ecotoxicity ; Environmental Risk Assessment

UE	CHEMISTRY FOR ALTERNATIVE ENERGIES	3 ECTS	1st semester
KCHV9AGU	Cours : 30h	Teaching in anglais	Personal work 45 h

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TEACHER IN CHARGE OF THE MODULE

DE CARO Pascale
Email : pascale.decaro@ensiacet.fr

LEARNING GOALS

At the end of the training, students will be aware of the socio-economic, technical and environmental issues related to the energy transition. They will have acquired knowledge of renewable raw materials, from which new energy technologies are implemented. They will be able to propose alternative energy sources or vectors to conventional fuels. The theoretical knowledge provided by the courses will be supplemented by concrete examples that will allow students to identify in particular the catalysts involved in production processes (fuel cells, biomass valorization and catalytic activation of CO2).

SUMMARY OF THE CONTENT

This course illustrates the major role of chemistry, and in particular catalysis, in the efficiency of energy components. In a national and international context that widely promotes low-carbon energies, this course addresses the fields of new energy technologies that are key to a sustainable energy future. Among them, the processes involved in : the production of electricity from solar energy, both for stationary and mobility applications ; the production, storage and use of hydrogen for various applications such as electric mobility ; the production of renewable energies with fuel cells and biopiles ; or energy uses of non-food biomass for the production of biofuels and biomethane, as well as CO2 recovery routes. Examples of catalytic processes leading to high value-added industrial products will also be presented.
Another part of this course is focalized on chemistry for Biomass and biomass for chemistry illustrated through examples in carbohydrate chemistry.
Through selective examples, we'll describe how Nature is inspiring how turning the chemical transformations sustainable, and how sugars represent molecular bricks of choice to access complex molecular scaffolds.

PREREQUISITES

Good level in organic chemistry and notions in materials chemistry and heterogeneous catalysis

SPECIFICITIES

Lecture in English

TARGETED SKILLS

- Know the components of biomass and the main associated transformation routes for the production of energy,
- Master the basic concepts of new energy technologies,
- Know the contributions of chemistry and catalysis for these new technologies,
- Be able to analyse a chemical problem in the context of new energy technologies and to be able to make proposals.

REFERENCES

— Les énergies renouvelables pour la production d'électricité, seconde édition, Leon Freris, David Infield, Dunod, 2021
— Valoriser le CO2, Presse de l'école des Mines -Technologies, Chakib Bouallou, Sciences & Techniques, Juin 2021.

KEYWORDS

alternative energies, fuel cell, biopiles, photovoltaic, hydrogen, CO2, biomass, production of biofuels, methanization, catalysis, storage..

UE	PROJECT (project)	3 ECTS	1st semester
KCHV9AIU	Cours : 10h , Projet : 50h	Teaching in anglais	Personal work 65 h
URL	https://moodle.univ-tlse3.fr/course/view.php?id=6682		

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TEACHER IN CHARGE OF THE MODULE

MARTY Jean-Daniel
Email : jean-daniel.marty@univ-tlse3.fr

DE VIGUERIE Nancy
Email : nancy.de-viguerie@univ-tlse3.fr

LEARNING GOALS

In order to develop eco-responsible processes, the evaluation of the environmental impacts of a product, a service, a company or a process is an essential prerequisite. The objective of this teaching unit is to present the life cycle assessment (LCA). This standardized evaluation method allows to identify the points on which a product can be improved and aims to prevent impacts related to human activities.
The students will have to propose a critical analysis of publications related to life cycle assessment, based on the use of software offering this type of analysis. This teaching will be carried out under a project format.

SUMMARY OF THE CONTENT

- Introduction : life cycle assessment (ISO 14040 standards), general principle and implementation (definition of the system's objectives, inventory of emissions and extractions, analysis of the environmental impact and interpretation)
- Methodology for carrying out an LCA : iterative approach (preliminary evaluation or screening, detailed analysis), "manual" calculation, summary presentation of existing calculation software
- Critical analysis of life cycle analysis published in the scientific literature.

PREREQUISITES

Knowledge of the principles of Green Chemistry & mastery of associated metrics. Knowledge of standards.

SPECIFICITIES

L ecture in English

TARGETED SKILLS

- Understand the life cycle assessment approach
- Know the databases (EcoInvent) and impact methods (CML, Impact 2002+, etc.)
- be able to analyze and critique a life cycle assessment already conducted
- be able to apply the life cycle assessment method using dedicated software
- be able to implement project management tools and present these results

REFERENCES

Life Cycle Assessment : Understanding and Performing an Ecobalance, Myriam Saadé, Olivier Jolliet and Pierre Crettaz

KEYWORDS

Life cycle assessment, eco-design, ISO 14040 standard

UE	ADVANCED HETEROCHEMISTRY AND STEROSELECTIVE SYNTHESIS (HETSYN)	3 ECTS	1st semester
KCHV9AJU	Cours : 20h , TD : 15h	Teaching in anglais	Personal work 40 h
URL	https://moodle.univ-tlse3.fr/course/view.php?id=3096		

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TEACHER IN CHARGE OF THE MODULE

MARTIN VACA Blanca Maria
Email : blanca-maria.martin-vaca@univ-tlse3.fr

LEARNING GOALS

The aim of this course is the detailed study of the chemistry of both main group elements and transition metals, with a special focus on stereoselective organic synthesis, metal-free catalysis as well as chemical transformations mediated homogeneously by organometallic complexes, all providing sustainable approaches. The first part will be devoted to the non-classical reactivity of p-block elements (B, Si, P, S...), including their peculiar properties and their use as new tools in modern synthesis. The second part deals with stereo- and enantioselective catalytic processes, with a special focus on mechanistic insights. Different sources of chirality and recent advances in asymmetric induction by chiral ligands will be studied in-depth.

SUMMARY OF THE CONTENT

P bloc elements (B, Si, P, S). **Properties :** Heavy element specificities (hyper-valency/-conjugation), Frustrated Lewis Pairs, small molecules activation, super Lewis acid. **Functionalization :** stereo-selective rearrangements of boranes, formation of C-B/Si bonds, directed reactivity of silanes, transformations mediated by phosphines. **Formation of C-C bonds :** enolate- and allyl-boranes and silanes, dithioacetals. Radical reactions. **Formation of C=C bonds :** Wittig (and related), and Peterson reactions.**Main group elements and Transition metals** : Ligands, Hydrofunctionalization, C-C and C-heteroatom bond formation.
Stereoselective synthesis and catalysis. **Modern stereochemistry** : Complements on stereochemical analysis. Concepts and general strategies in enantioselective synthesis and catalysis. Chiral ligands. **Chiral transition metal complexes** : Synthesis and reactivity. Central and planar chirality (Ti, Fe, Cr, ...). **Enantioselective catalysis :** Organic and organometallic catalysis. Enantioselective transformations : oxidations (Ti, Mn, Os) ; reductions (Rh, Ru, Ir) and formation of C-C bonds (Ni, Cu, Pd). Historical motivations and prospects of applications in pharmaceutical synthesis.

PREREQUISITES

Basic organic chemistry, basic organometallic chemistry, concepts in catalysis, stereochemistry.

SPECIFICITIES

Courses will be in English language

TARGETED SKILLS

Achieve a chemical transformation involving a heteroelement and/or to carry out a chemical transformation in a stereoselective manner according to the rules of the green chemistry
Design and implement syntheses in a context of sustainable development

REFERENCES

Organic Synthesis : The role of Boron and Silicon, Thomas Oxford Chemistry Primers, 1992
Fundamentals of Asymmetric Catalysis, Walsh & Kozlowski, University Science Books, 2009
Organic chemistry, Clayden, Oxford University Press, 2012

KEYWORDS

Main-group elements, Transition metals, Organometallic complexes, Hydrofunctionalization, Catalysis, Stereochemistry, Stereoselective synthesis, Chiral ligands

UE	STAGE (internship)	30 ECTS	2nd semester
KCHVAAAU	Stage : 6 mois	Teaching in anglais	Personal work 750 h
URL	https://moodle.univ-tlse3.fr/course/view.php?id=3324		

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TEACHER IN CHARGE OF THE MODULE

CIUCULESCU-PRADINES Diana
Email : eliza.ciuculescu-pradines@utoulouse.fr

DE VIGUERIE Nancy
Email : nancy.de-viguerie@univ-tlse3.fr

LEARNING GOALS

This 5-6 month internship is intended as a first experience in real world RnD situations. It is an opportunity to put in practice the theoretical understandings of chemistry in a professional environment and to further develop the skills that are necessary for professional integration.
This internship is the perfect opportunity to explore various career choices. The internship in industry will help you familiarize with the chemical industry and better prepare your professional integration at the end of your Master's. The internship in an academic research settings is geared towards a future PhD.

SUMMARY OF THE CONTENT

Starting in January and until June, the students will carry out a full time, research-based internship, counting towards 30 ECTS. The internship topic must match the preoccupations of green chemistry. It can be carried out in an academic or industrial laboratory, in France or abroad. Students are strongly incited to find an internship either in industry in order to facilitate their future professional integration, or in an academic lab abroad to broaden their horizons.
In Toulouse, the Green Chemistry Master's course is associated with a number of chemistry research laboratories that are affiliated with the graduate school Ecole Doctorale des Sciences de la Matière (EDSM, www.edsdm.ups-tlse.fr), as well with companies with a focus on green chemistry.
In either cases, you will be an integral member of a research team and will take asked to attend meetings and conferences, present your results...

PREREQUISITES

knowledges from his training in green chemistry

TARGETED SKILLS

Acquire and develop necessary skills to enter the professional life. General skills : sociability, adaptability, communication (preparing communication materials, speaking professionally), organization (establish priorities, pose a problem and define objectives), autonomy, **initiative** , **receptiveness** , collaboration (knowing how to work in a team, knowing how to work in a network), professional environment (know the company, know and use the standards of quality, safety, environment...), **critical thinking** (knowing how to analyze and evaluate a situation or issue and form a judgment), bibliographic research and information processing.At these skills are added all the specific skills acquired by each student depending of the specificity of his internship topic. Some examples are : use of specific characterization techniques, learning about a specific subject, use and apply the green chemistry principles in the context of his own internship.

KEYWORDS

internship

GLOSSARY

GENERAL TERMS

DEPARTMENT

The departments are teaching structures within components (or faculties). They group together teachers lecturing in one or more disciplines.

MODULE

A semester is structured into modules that may be mandatory, elective (when there is a choice) or optional (extra). A module corresponds to a coherent teaching unit whose sucessful completion leads to the award of ECTS credits.

ECTS: EUROPEAN CREDITS TRANSFER SYSTEM

The ECTS is a common unit of measure of undergraduate and postgraduate university courses within Europe, created in 1989. Each validated module is thus assigned a certain number of of ECTS (30 per teaching semester). The number of ECTS depends on the total workload (lectures, tutorials, practicals, etc.) including individual work. The ECTS system aims to facilitate student mobility as well as the recognition of degrees throughout Europe.

TERMS ASSOCIATED WITH DEGREES

Degrees have associated domains, disciplines and specialities.

DOMAIN

The domain corresponds to a set of degrees from the same scientific or professional field. Most of our degrees correspond to the domain Science, Technology and Health.

DISCIPLINE

The discipline corresponds to a branch of knowledge. Most of the time a discipline consists of several specialities.

SPECIALITY

The speciality constitutes a particular thematic orientation of a discipline chosen by a student and organised as a specific trajectory with specialised modules.

TERMS ASSOCIATED WITH TEACHING

LECTURES

Lectures given to a large group of students (for instance all students of the same year group) in lecture theatres. Apart from the presence of a large number of students, lectures are characterized by the fact they are given by a teacher who defines the structure and the teaching method. Although its content is the result of a collaboration between the teacher and the rest of the educational team, each lecture reflects the view of the teacher giving it.

TD : TUTORIALS

Tutorials are work sessions in smaller groups (from 25 to 40 students depending on the department) led by a teacher. They illustrate the lectures and allow students to explore the topics deeper.

TP : PRACTICALS

Teaching methods allowing the students to acquire hands-on experience concerning the knowledge learned during lectures and tutorials, achieved through experiments. Practical classes are composed of 16 to 20 students. Some practicals may be partially supervised or unsupervised. On the other hand, certain practicals, for safety reasons, need to be closely supervised (up to one teacher for four students).

PROJECT

A project involves putting into practice in an autonomous or semi-autonomous way knowledge acquired by the student at the university. It allows the verification of the acquisition of competences.

FIELD CLASS

Field classes are a supervised teaching method consisting of putting into practice knowledge acquired outside of the university.

INTERNSHIPS

Internships are opportunities enabling students to enrich their education with hands-on experience and to apply lessons learned in the classroom to professional settings, either in industry or in research laboratories. Internships are strongly regulated and the law requires, in particular, a formal internship convention established between the student, the hosting structure and the university.


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