


Teacher(s)	Gaigneaux Eric ;Riant Olivier ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	<p>Generalities on catalysis : Recall of the basic principle of catalysis. Homogeneous, heterogeneous catalysis and heterogenisation of homogeneous catalysis. Description and comparison of elementary processes in these two categories of catalysis.</p> <p>Part I : homogeneous catalysis :</p> <ol style="list-style-type: none"> Basic principles of homogeneous catalysis. <ul style="list-style-type: none"> - Recall of basics in organometallic chemistry (16-18 electron rule, classification of ligands, donation and retrodonation). - Elementary reactions: ligand substitution, oxidative addition, reductive elimination, insertion, oxidative coupling. - Ancillary ligands: mono and di-phosphines case, cone angles, diaminocarbenes ligands. - Principle of catalysis by phase transfer. Some examples of important industrial processes using homogeneous catalysis. Examples: alkene hydrocyanation (nylon channel), alkene hydroformylation, acid acetic synthesis, oxidation processes, biphasic processes. <p>Part II : heterogeneous catalysis :</p> <ol style="list-style-type: none"> Basic principles of heterogeneous catalysis. Review of principal kinetic models of heterogeneous catalysis (Langmuir-Hinshelwood, Eley-Rideal, Mars -van Krevelen) Illustrations in the following areas: petrochemistry (hydrotreatment, catalytic cracking, oxidation and ammoxidation of propene, epoxidation of ethylene, oxidation of butane in maleic anhydride, use of zeolites,), environment (DeNOx, exhaust gases) and basic inorganic chemistry synthesis (ammonia, sulphuric acid,).
Learning outcomes	<p>At the end of this learning unit, the student is able to :</p> <p>This teaching aims :</p> <ol style="list-style-type: none"> at providing future chemists a global and unified vision of catalysis, describing and comparing elementary processes in homogeneous and heterogeneous catalysis, and at illustrating the importance of the two categories of catalysis at the industrial level.
Evaluation methods	<p>The exam consists of two parts (homogeneous catalysis and heterogeneous catalysis), each of which is worth 10 points; the sum of the marks of each part constitutes the mark out of 20 for the whole course. For the heterogeneous catalysis part specifically : closed book written exam, with specific questions, but also transversal questions requiring to activate the knowledge on the whole course.</p>
Teaching methods	<p>For the heterogeneous catalysis part :</p> <p>Lecture with use of a powerpoint available on Moodle at the beginning of the teaching. A constant interaction with the students is established in the form of questions and answers involving them in debates on specific issues, allowing them to integrate the material during the session.</p>
Content	<p>Heterogeneous catalysis part :</p> <ol style="list-style-type: none"> Basic principles of heterogeneous catalysis; description of the different steps of the heterogeneous catalytic cycle: diffusions, adsorption-desorption, reaction, and their impact on the global performances Review of the main kinetic models of heterogeneous catalysis (Langmuir-Hinshelwood, Eley-Rideal, Mars -van Krevelen) Illustration via two case studies: the automotive catalytic converter, and biomimetic catalysts, as well as via examples from the petrochemical industry discussed continuously in the course.
Inline resources	For the heterogeneous catalysis part :

	The course notes used by the teacher constitute a syllabus, and are made available on the Moodle platform before the start of the course; printing them (in mode 2, max 4 slides per side) is highly recommended.
Other infos	By heterogeneous catalysis : this part of the course can be given in English.
Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemistry	CHIM2M	3		
Master [60] in Chemistry	CHIM2M1	3		