Universitat de Lleida

DEGREE CURRICULUM

CHEMICAL REACTION ENGINEERING

Coordination: PUIG VIDAL, RITA

Academic year 2018-19

CHEMICAL REACTION ENGINEERING 2018-19

Subject's general information

Subject name	CHEMICAL REACTION ENGINEERING
Code	102341
Semester	1st Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Not informed	3	COMPULSORY	Attendance-based

Course number of credits (ECTS)	6
Type of activity, credits, and groups	

Activity type	PRALAB	PRAULA	TEORIA
Number of credits	0.4	2.6	3
Number of groups	1	1	1

Coordination	PUIG VIDAL, RITA
Department	COMPUTER SCIENCE AND INDUSTRIAL ENGINEERING
Teaching load distribution between lectures and independent student work	40% class 60% autonomous work
Important information on data processing	Consult this link for more information.
Language	catalan
Distribution of credits	Theoretical credits 2 Practical credits 4

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
PUIG VIDAL, RITA	rita.puig@udl.cat	6	

Subject's extra information

Continuous work during the semester is recommended in order to achieve the aims of the subject. It is also important to visit frequently the virtual space associated with the subject.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Laboratory gown from UdL
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos
Centre the Cultures i Cooperació Transfronterera

http://www.publicacions.udl.cat/

There will be a specific service for the *Campus Universitari d'Igualada*.

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.
- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: http://www.sprl.udl.cat/alumnes/index.html

Learning objectives

CHEMICAL REACTION ENGINEERING 2018-19

In this subject, the fundamental concepts of Chemical Reaction Engineering are studied. Specifically:

- The kinetics or speed at which a reaction takes place.
- The relationship of this kinetics with the reaction mechanisms.
- How experimental conditions are affecting the kinetics of a reaction.
- How can we find the kinetic equation from some experimental data.
- How to use the kinetic equation to design the reactor where this reaction will take place at industrial scale.

The final goal is that the student achieve the necessary criteria to know how to optimize the experimental conditions to perform the reaction at an adequate speed and how to favor the desired reaction products.

Competences

The most significant skills that will be worked on in this subject are:

B01 Students demonstrate to possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply knowledge coming from the vanguard of this field of study.

CG4 Solve problems with initiative, make decisions, creativity, critical reasoning and communicate and transmit knowledge, skills and abilities in the field of Industrial Chemical Engineering.

CE19. Calculate balances of matter and energy, biotechnology, material transfer, separation operations, chemical reaction engineering, design reactors, and value and transform raw materials and energy resources.

CT5. Apply essential notions of scientific thinking.

Subject contents

The program is structured in 7 themes with a teaching load for 60-hour students and a total dedication of about 150h. The themes are the following:

- TOPIC 1. INTRODUCTION.

Utility of kinetics. Experimental factors/conditions that intervene in the speed of a reaction.

- TOPIC 2. EXPERIMENTAL METHODS TO FIND THE KINETIC EQUATION: DISCONTINUOUS REACTOR AND LIQUID PHASE.

We will study how we can obtain the kinetic equation of a reaction from experimental data in the laboratory: reagent concentration at different reaction times.

- TOPIC 3. KINETICS OF GAS PHASE REACTIONS.

How to obtain, from experimental data, the kinetic equation of reactions that take place in the gas phase (different than the liquid phase reactions studied in the previous topic).

- TOPIC 4. MULTIPLE REACTIONS.

When mixing certain reagents, they may react in more than one way, that is, more than one reaction may take place. In this case, we talk about multiple reactions. In this unit, the experimental conditions to favor the desired product will be discussed.

- TOPIC 5. EXPERIMENTAL METHODS TO FIND THE KINETIC EQUATION IN CONTINUOUS REACTORS.

In previous units, the experimental data was obtained in the laboratory through a batch reactor. In this chapter, we will see what data we can obtain experimentally with a continuous reactor and how these data helps to obtain the kinetic equation of the reaction.

- TOPIC 6. INTRODUCTION TO REACTOR DESIGN.

We will study how we can calculate the dimensions and the appropriate reactor to carry out a reaction, knowing its kinetic equation and the production we want to obtain.

- TOPIC 7. CATALYTIC REACTIONS.

How to find the kinetic equation of a reaction taking place in the presence of a catalyst.

Methodology

The methodology will basically consist in introducing some theoretical concepts and working them through the resolution of problems. Some laboratory experiments will also be performed (0.4 ECTS).

The subject is structured in 7 topics that collect the set of concepts to develop during the course. Each topic takes one or two weeks. The topics are organized in a didactic way so that a new topic is related to the previous ones and includes new concepts that are supported by others that have already been seen. In this way, the conceptual framework of the subject is gradually being built.

Each topic contains activities to be carried out in a non-contact manner by the student. Normally, the activities consist in the study of a section using the material indicated for the follow-up of the subject and the resolution of a set of proposed problems.

Each face-to-face session implies the presentation of the exercises proposed in the previous session or, the accomplishment of a small test of acquired knowledge on a finished subject. These exercises and tests will contribute to the final grade of the student. The presentation of the exercises will be done via e-mail or on paper to the next face-to-face session.

Development plan

Topic	Weeks	Methodology	Hours in class	Hours of autonomous work
1.Introduction	1-2	Master class and problems	8	12
2.Discontinuous reactor, liquid phase	3-4	Master class and problems	8	12
3.Gas phase reactions	5-7	Master class and problems	12	18
Midterm Exam	8	Written test	2	3
Laboratory	9	Experimental	4	6
4.Multiple Reactions	10	Master class and problems	4	6
5.Continuous reactors	11-12	Master class and problems	8	12
6.Reactor design	13-14	Master class and problems	8	12
7.Catalytic reactions	15	Master class and problems	4	6
Final Exam	16	Written test	2	3
		TOTAL	60	90

Evaluation

At the end of the course there will be a final written exam of 2 hours duration in which neither books nor notes will be allowed.

The evaluation of the subject will take into account the grade of the written final exam and other grades with the following weighting:

Final Exam Written:	40%
Partial exams:	30%
Exercises:	20% (compulsory)
Practices:	10% (compulsory)

Anyone who has not passed the course at the first opportunity will be able to take a final recovery exam that will include all the contents of the subject. This recovery exam will take place during the week proposed in the academic calendar.

Bibliography

The main resource are the notes of the subject.

Further reading:

- Ingeniería de las reacciones químicas. G.O.Levenspiel. Ed. Reverté. 1992.
- Introducción a la Ingeniería Química. G. Calleja. Ed. Síntesis. 1999.