COURSE DATA

Data Subject	
Code	34760
Name	Chemical Reaction Engineering I
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)			
Degree	**Center**	**Acad. year**	**Period**
1401 - Degree in Chemical Engineering	School of Engineering	2	Second term

Subject-matter		
Degree	**Subject-matter**	**Character**
1401 - Degree in Chemical Engineering	16 - Chemical reaction engineering	Obligatory

Coordination	
Name	**Department**
BERNA PRATS, ANGEL	245 - Chemical Engineering

SUMMARY

Chemical Reaction Engineering I is a part of the matter of the same name. His general objective is the increase of the knowledge of kinetics of chemical reactions and the combination of this knowledge with the bases of chemical engineering in order to apply them to the design and operation of the reactors of the chemical and biochemical industry.

Chemical reactors are the object of study of the Chemical Reaction Engineering. This study has two slopes, the analysis of the behaviour and the design of the equipment and of its operating. It is a very applied field. With this knowledge one can study the behaviour and the design of different chemical reactors.

The practical part tries of study different applications of the exposed concepts, thus, for example, the necessary volume of the reactor to get a conversion or a production will be calculated, and it will be analysed the effect of modify some parameter, as for example the temperature of operation. The interpretation of results will be an important part of the learning process.

It is a compulsory subject that is imparted in the second semester of the second year of the Chemical Engineering degree. It has assigned 6 ECTS credits.

With this subject of study we tries to give an overview of the Chemical Reaction Engineering and to provide the students the necessary knowledge of the basics of the processes of chemical reaction, introducing the necessary tools for analysis and design of chemical reactors. These tools will be the combination of balances with the rate equations. This way, it will be established the essential bases in order to a successfully application.

Once the items will be introduced they will be used in order to solve a series of problems. Students will practice with these concepts and procedures in other subject.

The content of this subject is: **Kinetics of chemical reactions. Ideal reactors. Basic equations of design. Design of ideal reactors. Biochemical reactors, polymerization reactors, membrane reactors. Basis of Biochemical Engineering.**

Classes of both theory and problems will be taught in Valencian as it appears in the subject sheet available on the web of the degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Differential and integral calculation, systems of equations solution (algebraic and differentials), numerical calculation, optimization, statistics, coordinate systems.
Stoichiometry, kinetics.
Equilibrium and heat of reaction, transmission of heat.
Change of units, Mass, energy and momentum balances, mass and heat transfer, mechanics of fluids.
Economy: Basic slight knowledge.
Software: Basic programs, programs to solve systems of equations (Polymath, MATLAB, etc).

OUTCOMES

1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.

- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.

- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.

- G6 - Ability to deal with specifications, regulations and mandatory standards.

- G10 - Ability to work in a multilingual and multidisciplinary environment.

- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.

- TE1 - Knowledge of material and energy balances, biotechnology, matter transfer, separation operations, chemical reaction engineering, reactor design, and valorisation and transformation of raw materials and energy resources.

- TE2 - Ability to analyse, design, undertake simulations and optimise processes and products.

LEARNING OUTCOMES

Learning results.

- To know and understand the basics of the applied kinetic chemistry. (G3,TE1)
- To apply the principles of mass and energy conservation in systems with chemical reaction. (G4,TE1,TE2)
- To apply the principles of thermodynamics and kinetics in systems with chemical reactions. (G4)
- To know the characteristics and mathematical models to describe the ideal reactors. (G3)
- To analyse the operation and dimensioning of the ideal isothermal reactors. (G3,G5,G6)
- To select the type and number of reactors to attain a conversion value. (G4)
- To know the specificities and applications of various types of industrial reactors: Catalytic, biochemical, of polymerization, of membrane. (G5)
- To know and apply the safety principles related to chemical reactors. (G6,G11)
- To prepare written reports. (G5,G10)
- To prepare designs both in individual and in group way. (G4)

At the end of the course students should be able to:

- To understand the phenomena involved in chemical reactions. To know the nomenclature and terminology.
- To calculate the composition changes and their impact on the reaction rate.
- To understand the parameters that influence the reaction rate and how this influence is.
- To combine aspects of the kinetics with which characterize the behaviour of the reactor (continuous, batch, etc.).
- To apply mass and energy balances necessary for the design and analysis of ideal reactors. This
- includes cases of varying density and multiple reactions, as well as membrane reactors and biochemical reactors.
- Apply this knowledge to design and prediction of reactor operation.
- To understand how the different chemical reactors work and to be able to make recommendations for different cases.
- Understand the special features of reactors such as the polymerization ones.
- To implement calculating procedures in a reasonable manner, justifying the results.
- To recognize the different kinds of information that appear in text associated with chemical reactions and reactors.

- To collect the information needed to formulate and solve a problem related to the design and/or analysis of a reactor.
- To manage the information with criteria.
- To identify and explain the physical meaning of each of the terms of the balance equations.
- To describe the equations of the chemical reactions kinetic and heat transfer.
- To explain the distinguishing features of the different ideal reactors.

Besides during the course will promote the acquisition by students of other social and technical abilities such as to:

- To extract information from the statement of a problem.
- To interpret and translate as variables the data of a problem.
- To interpret correctly other data, definitions and relationships of the process and write them in form of equations.
- To write the appropriate boundary conditions for the integration and resolution of problems.
- To solve the problem using appropriate mathematical tools.
- To interpret and reasoning the results of a problem.
- To interpret experimental results and report them.
- To organize calculations in a systematic way
- To make calculations accurately and substantiated.
- Capacity for analysis and synthesis.
- Trained to work individually and in groups
- Ability to allocate time between tasks effectively.
- Ability to argue with logic and reasoned criteria.
- To write reports of issues solved in a way that reveals the information used, the procedures and analysis of results
- To show in public the results with use of a convenient means

DESCRIPTION OF CONTENTS

1. INTRODUCTION AND GENERAL CONCEPTS.

Chemical engineering and chemical reactors engineering. Reactions and kinds of reactors. examples

2. PHENOMENOLOGY OF CHEMICAL REACTIONS.

Stoichiometry. Independence of chemical reactions. Measures of the progress of the reaction, selectivity, etc. Chemical equilibrium. Kinetics. Types of reactors. Material, energy and momentum balances in systems with chemical reactions.

3. IDEAL REACTORS. ISOTHERMAL BEHAVIOR.

The Continuous Stirred Tank Reactor (CSTR). The discontinuous stirred tank reactor (batch). The continuous tubular or plug flow reactor (PFR). Semicontinuous reactors. Combination of reactors

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4. MULTIPLE REACTIONS.

Qualitative and quantitative analysis of different systems. Optimization. Polymerization Reactors.

5. BIOCHEMICAL REACTORS.

Introduction to biochemical engineering. Enzyme and microbial kinetics. Design of biochemical reactors.

6. UNCONVENTIONAL REACTORS.

CVD reactors. Membrane reactors. Reactions in supercritical environment.

WORKLOAD

ACTIVITY	Hours	% To be attended
Classroom practices	35,00	100
Theory classes	25,00	100
Development of group work	15,00	0
Development of individual work	15,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	30,00	0
TOTAL	150,00	

TEACHING METHODOLOGY

To successfully develop the subject it is necessary to follow different strategies: theory and problems lessons in the classroom, seminars, individual and group work and tutoring.

 1 .- Lessons in the classroom. (G3,G4,G5,G6,G10,G11,TE1,TE2)

These lectures will be of theory or problems according to the needs of the moment. Thus, first it will be presented the theory and then the practical applications.

The model used is as follows: the theory will be exposed briefly by the teacher. It should indicate where the student can find texts for more complete discussion, promoting individual work.

Practical classes of problems will be developed following two models. In some of the lectures the teacher will solve a series of sample problems for to identify the essential elements of the approach and problem resolution. In other kinds of problems will follow a participatory model following a seminar methodology, students will solve problems individually or arranged in groups (cooperative learning), under the supervision of the teacher. After the work, the problems will be collected, analysed and corrected by the teacher or the students themselves.

2 .- Seminars. (G3,G4,G5,G6,G10,G11,TE1,TE2)

The seminar sessions are used to study in more detail some aspects. Thus, a session can be used to demonstrate the use of the Internet to find information related to the subject, as characteristics of the reactors, reaction kinetics, safety. Another may be used to practice with some useful tools for the subject. One of the tasks to be assigned for processing outside of class will be a literature search.

In another session can be practiced the work in group by assigning to each member a different job: one of them plays the role of leader, organizing work, assigning tasks to others and making the findings, another student may be responsible for developing information regarding with the kinetics and equilibrium, a third student prepares the application of mass and energy balances using the information provided by the second. Finally, a fourth student plays the role of critical related to the work done, proposing alternatives and ways to extend or continue the problem. These roles should be reflected in the report and will be interchangeable in future works.

3 .- Individual study. (G3,G4,G5,G6,G10,G11,TE1,TE2)

Students should study in an independent way to assimilate the knowledge represented, and to practice these problems proposed. The distribution of the problem statements will be made through the Virtual Classroom. The Virtual Classroom is also used to distribute educational materials.

Some of these problems will be solved in class; others should be solved by the students individually or in groups and delivered the solution to the teacher before the deadline. The activities can be problems, obtaining information from the literature or any website, discussion of an item, and so on.

It will be controlled the authenticity of the authorship of the work. Failure to perform this work must be very well justified.

4 .- Tutorials. (G3,G4,G5,G6,G10,G11,TE1,TE2)

Students may consult the teacher directly in class or attending the tutorials in the schedule. They can also make inquiries via email.

5 .- Teamwork. (G3,G4,G5,G6,G10,G11,TE1,TE2)

The proposed work for students can be solved individually or in groups. They will be encouraged to work in groups in order to develop organizational skills, responsibility and solidarity.

EVALUATION

The final grade will have two contributions, the first one (60 %) corresponds to the exam (G3,G4,G5,G6,G10,G11,TE1,TE2), the second one (40 %) (G3,G4,G5,G6,G10,G11,TE1,TE2) will be related to the development of homework (15 %), with activities in the classroom along the course (20 %) and with the student participation in class during the course (5 %). Special attention to oral and written presentation of problems solved and works. It will be valued the collaboration within the group. For students who express unable to attend class, the final grade will be the result of combining the exam (80 %) with that activities solved outside of class (20 %).

The exam will consist of theory (questions) and problems, for answer the theory the students can dispose of a form (one sheet), and for the problems solution they can use books, notes.

Examination and activities will be scored over 100 points; to pass the subject should at least get 40 points in the exam and 50 in the final grade.

The only recoverable activity is the examination, in the second call

In any case, the assessment system will be governed by that established in the Reglament de Avaluació i Qualificació de la Universitat de València per a títols de Grau i Màster (http://links.uv.es/7S40pjF)

REFERENCES

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- http://www.engin.umich.edu/~cre/index.htm

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Continguts

Es mantenen els continguts inicialment arreplegats a la guia docent.

2. Volum de treball i planificació temporal de la docència

Reducció del pes d'unes activitats i substitució per altres mantenint el volum de treball que marca la guia docent original.

Ha disminuït la docència presencial i ha augmentat el treball per part de l'estudiant.

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3. Metodoloia docent

- Pujada de materials a l'Aula Virtual
- Proposta d'activitats per Aula Virtual
- Transparències amb locució
- Problemes/exercicis resolts (classes pràctiques/laboratoris)

4. Avaluació

El canvis relatius a la guia docent original són el següents:

• Addició d'activitats d'avaluació continua

• Increment del pes en la nota final de l'avaluació continua. Nova forma d'avaluar als alumnes que han seguit el curs de manera presencial: examen 40 %, activitats per a resoldre a casa 15 %, activitats resoltes a classe (incloses les virtuals) 40 % i participació 5 %

• Prova escrita oberta (examen tradicional) però distribuïda en Aula Virtual

La resta de criteris d'avaluació queden com a la guia docent original.

5. Bibliografia

La bibliografia recomanada es manté perquè és accessible.