Universitat Autònoma de Barcelona

2023/2024

Reactors, Instrumentation and Control

Code: 103226
ECTS Credits: 6

Degree	Type	Year	Semester
2501925 Food Science and Technology	OB	2	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Albert Canet Morral

Prerequisites

No official requirements are defined for this course. However, we strongly recommend that the student has passed through the courses: process fundamentals (second bachelor year, first semester) and Chemistry II (first bachelor year, second semester), therefore being able of, (i) using and correct application of required mathematical tools for processes analysis; (ii) application of stoichiometry for basic calculation in chemical reactions; (iii) identifying, analyzing and solving mass and energy balances at both steady and transient states without chemical reaction for simple processes in the food industry.

Objectives and Contextualisation

The course ***Reactors, instrumentation and control*** in the bachelor.

This course belongs to the second bachelor year and it is mandatory. The course introduces the students in the production systems that involve chemical reactions, the concept and types of ideal reactors and the main deviations from ideality. In this sense, it will be assumed that the student has passed through the course Processes fundamentals, and therefore that he/she knows the mass and energy balances in production systems without chemical reaction.

On the other hand, any equipment or process, independently of the scale (full industrial scale, laboratory or even domestic food processes) require of monitoring and control of the operation. Therefore, the student will be introduced into the basis of process control and required instrumentation for the common operations found in the food industry. Extra attention will be paid to the environmental and economic consequences of the reactor type selected as well as the control system decided.

Competences

- Analyse, summarise, resolve problems and make professional decisions.
- Apply the principles of biology and chemical engineering to describe, analyse, control and optimise the processes of food transformation and conservation.
- Apply the scientific method to resolving problems.
- Develop individual learning strategies and planning and organisation skills.
- Show sensitivity to environmental, sanitary and social issues.

Learning Outcomes

1. Analyse, summarise, resolve problems and make professional decisions.
2. Apply the scientific method to resolving problems.
3. Describe the characteristics and use of the different systems for controlling processes.
4. Develop individual learning strategies and planning and organisation skills.
5. Evaluate the behaviour of reactors depending on their operating mode.
6. Select the most suitable industrial measurement instrument for each application.
7. Show sensitivity to environmental, sanitary and social issues.

Content

1. INTRODUCTION

Unit 1. Introduction: operations and processes in the food industry

Use of reactors in the food industry. Importance of monitoring and control processes.

2. MASS BALANCES IN SYSTEMA WITH CHEMICAL REACTIONS

Unit 2. Systems with chemical reaction (I): stoichiometry, reaction rate and balances

Stoichiometry. Expressing the variation in masss for the different chemical species involved in the reaction. Limiting reagent, excess reagent. Aplication of mass balances to systems with chemical reaction. Heat of reaction and equilibrium. Rate and reaction kinetics.

Unit 3. Systems with chemcial reaction (II): reactors

Classification of the reactors. Ideal reactors. Combination of ideal reactors. Real reactors. Heterogeneous reactors.

3. CONTROL AND INSTRUMENTATION

Unit 4. Process control fundamentals

Goals of the control system. Automatic control versus manual control. Concepts and definitions.

Unit 5. Feedback control. Mathematical modeling and process dynamics

Feedback control. Process dynamics. Mathematical modeling and process simulation.

Unit 6. Physical elements of a control system. Instrumentation

Sensors: classification, characteristic parameters, specifications. Controllers: typology & selection. Actuators: control valves. Advanced control: feedforward, feedback-feedforward, cascade control.

Methodology

The course is fundamentally practical and is based in the following activities:

1) Theoretical lectures .

The student acquires the concepts and abilities related to the course attending to theoretical lectures complemented with personal study. Moreover, examples and practical cases will be used to strengthen the teaching and will provide the opportunity to students to participate in their resolution inside the theoretical lectures.

2) Problems workshops

The concepts acquired in the theoretical lectures are applied to problem resolution or to practical cases. In the problems workshops the strong interaction between students and professor will be enhanced to complete and deepen in the understanding of the concepts introduced in the theoretical lectures. The students work individually or in group as a function of the problem to be solved.

3) Seminars

They are an additional tool to review and to consolidate the work done in the theoretical lectures and problems workshop. They will be used also to solve doubts appeared during the course and to solve the tests.

4) Autonomous and collaborative study, problem resolution and search of additional information

These are autonomous activities that will be use by the student to consolidate the knowledge acquired in the rest of activities and to develop the corresponding competences. The autonomous resolution of problems is the base of the learning process, although it is judged interesting as well to form small working groups to get advantage of collaborative learning. It will be also required to expand the information presented by the professor for some of the units, and to prepare a presentation.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Autonomous and collaborative study	30	1.2	5, 7, 3, 4, 6
Problems workshops	16	0.64	1, 2, 5, 7, 3, 4, 6
Seminars	4	0.16	1, 2, 5, 7, 3, 4, 6
Type: Autonomous			
Autonomous and colaborative study	30	1.2	1, 5, 3, 4, 6
Problems and cases resolution	50	2	1, 2, 5, 3, 4, 6

Assessment

The competences of the course will be evaluated through:

a) A test for each of the parts of the course (individual):

Test 1: Units 1, 2 and 3 (Introduction to mass balances in systems with chemical reaction): 40% of the final score

Test 2: Units 4, 5 y 6 (Control & Instrumentation): 30% of the final score

b) Individual and/or collaborative activities carried out inside and outside the classroom: 30% of the final score.

A student fails the course if he/she does not attend to one of the tests, independently if he/she has done the individual and/or collaborative activities. The score will be the result of applying the corresponding fractions as previously stated.

The student cannot be evaluated if he/she has participated in evaluation activities with $\leq$ 15% of the final score.

To pass the course 5 points (out of 10) are required, calculated as weighed average of the tests and individual and collaborative activities, following the distribution of scores just described.

A recuperation test is foreseen including both controls. If the student attends the recuperation test, he/she will be examined only for the corresponding part that was failed (test with a mark less than 5 out of 10).

The individual and cooperative activities cannot be recuperated; they can only improve the mark the student achieved in the tests. If the score of the individual and collaborative activities worsens the final mark of the course, the evaluation of the individual and collaborative activities will be not considered to stablish the final score.The single assessment will consist of a single test in which the contents of the entire program of the subject will be evaluated. The grade obtained in this synthesis test will mean 100% of the final grade for the subject. The single assessment test will take place on the day, time and place ofthe last continuous assessment test of the subject. The single evaluation can be recovered on the day set for the recovery of the subject.

The single evaluation process will consist of a single test in which the contents of the entire program of the course will be evaluated. The grade obtained in this synthesis test will mean 100% of the final grade for the course.
The single evaluation test will take place on the day, time and place of the last continuous exam of the subject.
The single evaluation can be recovered on the day set for the recovery of the subject/course.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final test (recuperation)	variable, as a function of the previously failed tests	4	0.16	1, 2, 5, 3, 4, 6
Individual and colaborative activities (inside and outside the classroom)	30%	10	0.4	1, 2, 5, 7, 3, 4, 6
Test 1	40%	3	0.12	1, 2, 5, 3, 4, 6
Test 2	30%	3	0.12	1, 2, 5, 3, 4, 6

Bibliography

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Ed. Síntesis, Madrid

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• Perry R.H. (1984) "Perry's Chemical Engineering Handbook". 6th ed. McGraw-Hill. New York

• Centro de Actividad Regional para la Producción Limpia "Fichas Medclean" http://www.cprac.org/es/descargas/documentos/fichas-medclean.

Software

There is no specific software associated to this course