Universitat de Lleida

DEGREE CURRICULUM

UNIT OPERATIONS OF CHEMICAL PROCESSES

Coordination: GARVIN ARNES, ALFONSO

Academic year 2019-20

Subject's general information

Subject name	UNIT OPERATIONS OF CHEMICAL PROCESSES
Code	14523
Semester	1st Q(SEMESTER) CONTINUED EVALUATION / UNDEFINED
Typology	Degree: Master's Degree in Industrial Engineering; Course: 1; Character: COMPULSORY; Modality: Attendance-based
Course number of credits (ECTS)	6
Type of activity, credits, and groups	Activity type: PRAULA / TEORIA Number of credits: 3 / 3 Number of groups: 1 / 1
Coordination	GARVIN ARNES, ALFONSO
Department	FOOD TECHNOLOGY
Teaching load distribution between lectures and independent student work	Classrom Work: 60h Independent student work: 90h
Important information on data processing	Consult this link for more information.
Language	Catalan: 80 % Spanish: 20 %
Office and hour of attention	Office E2.2.15 Campus ETSEA Date set by mutual agreement with the teacher Phone: 973 70 29 07

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
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GARVIN ARNES, ALFONSO	alfonso.garvin@udl.cat	6	

Subject's extra information

A unit operation is each one of the steps that can be found in any industrial process (wheter chemical or not).

This subject studies the most usual and important unit operations in the chemical industrial proceses. So, it will consist of applying the Process Engineering to Chemical processes. All the concept that will be studied will be able to be used in any industrial process: food, biotechnology, chemist, etc.

The unit operations studied are the following:

- Distillation

- Solit/Liquid Extraction

- Humidification / Dehumidification / Drying

- Dessign of reactors

Prerequsites: To follow this subject properly, some previous knowledge on chemistry and mathematics are recommended.

Learning objectives

The main aim of this subtject is to know the classification of all the unit operations along with the fisical-chemical fundamentals and the mathematical models for the most important unit operations involved in the chemical industry.

1. To know the classificacion of all the unit operations as a function of the property transferred: mass, energy, mass-energy, momentum and other complementary unit operations.
2. To know how the following unit operations work:
    1. Distillation
    2. Solid-liquid extraction
    3. Drying
    4. Chemical reaction
3. To know the fundamentals of each unit operation.
4. To know the magnitudes, nomenclature and units for each unit operation.
5. To know how to obtain and work with the mathematical models for both each unit operation and each operation mode.
6. To know how to use the mathematical models so as to solve numerical problems related to the dessign and operation of the equipment needed for each unit operation.

Competences

Basic competences:

- **CG6**. To have suitable knowledge of the scientific and technological issues of: mathematical, analytical and numerical methods in engineering, electrical engineering, energetic engineering, chemical engineering, mechanical engineering, mechanics of continuous means, industrial electronics, automation, manufacture, material, quantitative methods of management, industrial computing, urbanism, infrastructures, etc.
- **CB3**. To be able to integrate knowledge and face complexity in order to make judgements from an information that, being incomplete or limited, it would include issues of social and ethical responsibilities directly related to the application of this knowledge and judgements.
- **CG7**. To project, calculate and design products, processes, installations and plants.
- **CG9**. To do research, development and innovation in products, processes and methods.

General Competences EPS:

- **CG2**. Capacity to consider the socioeconomic context as well as the sustainability criteria in the engineering solutions.

Specific competences set in ORDEN CIN/311/2009:

- **CE4**. Capacity for the analysis and design of chemical processes.
- **CE7.** Capacity to design electronic and industrial instrumentation systems.

Cross-disciplinary UdL competences:

CT1. Appropriate skills in oral and written language.

Subject contents

0.- Introduction. Classification of unit operations.

1. Distillation
    1. Introduction
    2. Liquid-vapour equilibrium
        1. Partial pressure. Dalton, Raoult and Henry Laws.
        2. Relative volatility.
    3. Distillation of binary solutions
        1. Simple distillation
        2. Flash distillation
    4. Continuous rectification of vinary solutions
        1. Number of plates
        2. reflux ratio
        3. In and out multiple streams
        4. Plate and column yield
2. Solid-liquid extraction
    1. Introduction
    2. Solid-líquid equilibrium
        1. Solution and solvent retention
        2. Triangular diagram
        3. Extraction operation methods
            1. One simple contact
            2. Repeated simple contanct
            3. Multiple countercurrent contact
3. Drying
    1. Introduction
    2. Air-water interaction
    3. Mass and energy balances
    4. Drying mechanisms
        1. Period of constant drying rate

    2. Period of decreasing drying rate
  5. Drying time
    1. Particle drying
    2. Tray drying
    3. Vibrating bed drying
4. Reactors dessignsDisseño de reactores
  1. Batch reactor
  2. Plug flow reactor
  3. Stirred tank reactor
  4. Real reactor

Methodology

- Master classes: the concepts are introduced by the professor without the active participation of the students, although, obviously the students can ask as many questions as they need so as the exposed concepts sink in.
- Problems resolution: the professor introduce a complex question with the aim that all the studients ans the very professor can solve it together in the same classroom.

Development plan

Week	Methodolgy	Items	Classroom hours	Student hours	Professor
1	Master class	0. Introduction	2	5	A. Garvín
1 i 2	Master class	1. Distillation	6	9	A. Garvín
3 i 4	Problems resolution	1. Distillation	6	9	A. Garvín
4 i 5	Master class	2. S-L Ext	4	6	A. Garvín
6	Problems resolution	2. S-L Ext	4	6	A. Garvín
7	Master class	3. Drying	4	6	A. Garvín
9	Evaluation. Written test.				A. Garvín
10	Problems resolution	3. Drying	2	3	A. Garvín
10 i 11	Master class	3. Drying	4	6	A. Garvín
11	Problems resolution	3. Drying	2	3	A. Garvín
12	Master class	4.1. Batch R.	2	3	A. Garvín
12	Problems resolution	4.1. Batch R.	2	3	A. Garvín
13	Master class	4.2. P.F.R.	1	1.5	A. Garvín

13	Problems resolution	4.2. P.F.R.	1	1.5	A. Garvín
14	Master class	4.3. S.T.R.	1	1.5	A. Garvín
14	Problems resolution	4.3. S.T.R.	3	4.5	A. Garvín
15	Master class	4.4. Real R.	4	6	A. Garvín
16	Problems resolution	4.4. Real R.	4	6	A. Garvín
17	Evaluation. Written test.				A. Garvín

Evaluation

Evaluation	Items	Evaluation activity	%	Week
1st Part	0-2	Written test	50	9
2on Part	3-4	Written test	50	17
Remedial exam	0-4	Written test	100	19

There will be a first call consisting of a continuous evaluation. If the first call is not approved, there will be a remedial exam. In order to pass the course, the mark has to be bigger or equal to 5.0.

The continuous evaluation will consist of two exams. The first one will take place in Novembre and will consist of two problems, one about item 1 and another about item 2. The second exam will take place in January and will also consist of two problems, one about item 3 and another about item 4. The mark of the first call will be the average of the 4 partial marks.

If the mark is less than 5.0, there will be another exam at the late January or at the early February. The student will be able to decide the items to be examined. The final mark will be the average between all the final partial marks for each item.

The students have to bring a calculator with ability to linear regressions. They can also bring all the documents attached in the virtual campus.

Bibliography

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