Course guide
330156 - BEQ - Chemical Engineering Fundamentals

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Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: MARIA DOLORS GRAU VILALTA

Others: Guimerà Villalba, Xavier

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Acquire knowledge of process theory.
2. Pose and solve the material and energetic aspects of any chemical-industrial process (balance sheets without reaction and balance sheets with reaction).
3. Identify the energy properties of different fuels.
4. Apply the balances of matter and energy to combustion processes (steam production boilers).

Transversal:
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
7. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
5. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

The subject consists of four hours of class per week, which are dedicated to explaining the theoretical foundations and solving problems.

LEARNING OBJECTIVES OF THE SUBJECT

Acquire knowledge of the theory of processes, in order to interpret the material and energy aspects of any chemical-industrial process.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Definition of the theory of processes

Description:
Definition of the theory of processes.
Units related to matter.
Units related to energy.

Specific objectives:
Introducing the concept of process theory and know how to manipulate the units related to material and energy issues.

Related activities:
3, 4.

Full-or-part-time: 4h
Theory classes: 3h
Self study : 1h

2. Mass balances without chemical reaction

Description:
Concept of mass balance: continuity equation.
Stationary and transitory processes.
Discontinuous and continuous processes.
Mixing and separation processes.
Parallel and counter current contact processes.
Processes with recirculation and purge.
Bypass processes.

Specific objectives:
Distinguishing the different types of chemical-industrial processes.
Solving material balances in processes without chemical reaction.

Related activities:
1, 2, 3, 4.

Full-or-part-time: 25h
Theory classes: 8h
Practical classes: 2h
Self study : 15h

3. Mass balances with chemical reaction

Description:
Conversion, selectivity and yield concept.
Balances on atomic and molecular species.
Balances in processes with recirculation: conversion per step and global conversion.

Specific objectives:
Solving material balances in processes with chemical reaction.

Related activities:
1, 2, 3, 4.

Full-or-part-time: 32h
Theory classes: 8h
Practical classes: 4h
Self study : 20h

4. Energy balances without chemical reaction

Description:
Internal, external and in-transit energy concept.
Approach of the energy balance.
Determination of sensible heat and latent heat.
Use of the water vapor tables.
Use of the psychrometric diagram.

Specific objectives:
Solving energy balances in processes without chemical reaction.

Related activities:
1, 2, 3, 4.

Full-or-part-time: 33h
Theory classes: 10h
Practical classes: 3h
Self study : 20h

5. Energy balances with chemical reaction

Description:
Enthalpy of reaction, variation with temperature.
Processes with heat transfer.
Adiabatic processes.
Reaction temperature.

Specific objectives:
Solving energy balances in processes with chemical reaction.

Related activities:
1, 2, 3, 4.

Full-or-part-time: 24h
Theory classes: 7h
Practical classes: 3h
Self study : 14h

6. Mass and energy balances: combustion processes

Description:
Type of fuels and energy properties.
Combustion reactions.
Mass and energy balances in a steam production boiler.

Specific objectives:
Knowing the different types of fossil fuels and their energy properties.
Solving material and energy balances in a real process, that of combustion in a boiler.

Related activities:
1, 2, 3, 4.

Full-or-part-time: 32h
Theory classes: 9h
Practical classes: 3h
Self study : 20h

ACTIVITIES

1. RESOLUTION OF PROBLEMS IN CLASS

Description:
Solving problems in class by students individually or in groups. The teacher will guide the resolution.

Specific objectives:
Understand, apply, analyze and discuss the theoretical concepts of the related content.

Material:
Compilation of problems (at the Athena campus, or occasionally on paper).
Recommended bibliography.
Problems solved by the teacher in class.

Delivery:
Delivery of the problems solved in group.
Evaluation by the teacher or co-evaluation between students (problem section).

Full-or-part-time: 8h
Self study: 2h
Theory classes: 6h

2. TROUBLESHOOTING AT HOME

Description:
Solving problems at home by individual students.

Specific objectives:
Understand, apply, analyze and discuss the theoretical concepts of the related content.

Material:
Compilation of problems (at the Athena campus, or occasionally on paper).
Recommended bibliography.
Problems solved by the teacher in class.

Delivery:
Delivery of solved problems.
Evaluation by the teacher and delivery of the correction to the students (problem section).

Full-or-part-time: 20h
Self study: 20h

3. ATENEA QUESTIONNAIRES

Description:
There will be 2 questionnaires that students must answer individually.
They will have 1 day to answer and 3 attempts for each questionnaire.
The grade will be the maximum grade obtained.

Specific objectives:
Checking the follow-up of the subject and the consultation of the available material.

Material:
Material at the Athena campus.
Recommended bibliography.

Delivery:
The questionnaires must be answered within the established period.
This evaluation will be taken into account in the participation section.

Full-or-part-time: 4h
Self study: 4h

4. INDIVIDUAL WRITTEN TEST

Description:
Individual tests in the classroom for the evaluation of theoretical concepts and problem solving, related to the content of the subject.
There will be 2 tests of 2 hours each:
- Test 1: Contents 1, 2 and 3.
- Test 2: Contents: 4, 5 and 6.

Specific objectives:
Resolution of mass and energy balances in several chemical-industrial processes.

Material:
Statements and calculator.
Compilation of tables and graphs.
Form made by each student.

Delivery:
Resolution of the evidence and presentation in writing.

Full-or-part-time: 14h
Self study: 10h
Theory classes: 4h

GRADING SYSTEM

Problems (evaluable activity: 1, 2 to 50%): 30%
Individual tests (evaluable activity 4): 70%

EXAMINATION RULES.

- Delivery of the proposed problems
- Completion of the Atenea Questionnaires
- Carrying out individual tests
- If any of the continuous evaluation activities is not carried out, it will be considered as not scored

BIBLIOGRAPHY

Basic:
- Felder, Richard M.; Rousseau, Ronald W. Principios elementales de los procesos químicos. 3ª ed. México: Limusa Wiley, 2003. ISBN 9681861698.
- Himmelblau, David Mautner. Principios básicos y cálculos en ingeniería química. 6ª ed. México: Prentice-Hall Hispanoamericana, 1997. ISBN 9688808024.
- Hougen, Olaf A.; Watson, Kenneth M.; Ragatz, R. A. Principios de los procesos químicos, Vol. 2 [on line]. Barcelona: Reverté, 1964 [Consultation: 14/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=12005. ISBN 8429140506.
- Vian Ortuño, Ángel. Introducción a la química industrial [on line]. 2ª ed. Barcelona: Reverté, 1994 [Consultation: 27/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=3214793. ISBN 842917933X.
- Peiró Pérez, Juan J. Balances de materia: problemas resueltos y comentados. València: Universidad Politécnica de Valencia, 1997. ISBN 8477215251.
- Sinnott, R. K; Towler, Gavin P. Chemical engineering design [on line]. Sixth edition. Kidlington, Oxford: Butterworth-Heinemann, an imprint of Elsevier, 2020 [Consultation: 31/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5787890. ISBN 9780081026007.

Complementary:
- Henley, Ernest J.; Rosen, Edward M. Cálculo de balances de materia y energia: métodos manuales y empleo de máquinas calculadoras [on line]. Barcelona: Reverté, 1973 [Consultation: 10/06/2022]. Available on: https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=2749627&site=ehost-live&ebv=EB&ppid=pp_I. ISBN 8429172289.

RESOURCES

Other resources:
Grau i Vilalta, Ma. Dolors. Bases de l'enginyeria química : esquemes, taules i gràfiques. Manresa: EPSEM, 2012.
Grau i Vilalta, Ma. Dolors. Bases de l'enginyeria química : recull de problemes. Manresa: EPSEM, 2012.