

Course guide

220006 - Q - Chemistry

Last modified: 19/07/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Morillo Cazorla, Margarita
Valverde Salamanca, Abel

Others: Morillo Cazorla, Margarita,
Valverde Salamanca, Abel
Ramon Portés, Eva
Ivanova, Kristina
Fernández González, Pol
Pérez Llanos, Germán

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. An understanding of the basic principles of general, organic and inorganic chemistry and the ability to apply this knowledge in engineering

Transversal:

02 SCS N1. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world's situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.

Basic:

CB01. That students have demonstrated knowledge and understanding in a field of study that part of the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks, includes some aspects that involve knowledge of the forefront of their field of study.

TEACHING METHODOLOGY

·Large group lessons: Development of theoretical concepts.
·Medium group lessons: Application of the theoretical concepts seen in big group lessons or acquired by the student through self-learning processes.
·Small group lessons: Laboratory practicals.
The Atenea platform will be used as a support tool to the three varieties of lessons described above.
Check the schedule to find out the language of instruction for each group.

LEARNING OBJECTIVES OF THE SUBJECT

Provide the basic chemical knowledge necessary for the study of other subjects that can be taken later.

Relate and apply theoretical concepts both in numerical problems resolution and in laboratory practices realization .

Provide tools so that they have the ability to search for information, select it and reflect on it, creating their own criteria and opinions.

Recognize chemistry as an experimental science and establish knowledge from experimentation in the laboratory.

At the end of the subject the student must be able to:

- Identify and write balanced chemical equations and perform stoichiometric calculations.
- Know the chemical elements and their properties.
- Understand the different types of chemical bonds.
- Understand, from the chemical bond, the formation of molecules and their properties.
- Relate the structure of molecules to intermolecular forces and the properties of matter.
- Know how to describe the states of matter.
- Understand and apply the concepts related to the speed of a chemical reaction.
- Understand and know how to apply the concept of chemical equilibrium, as well as the factors that affect it.
- Know the applications of redox reactions in electrochemical batteries and electrolysis.
- Acquire some basic knowledge about compounds and reactions in organic chemistry.

STUDY LOAD

Type	Hours	Percentage
Hours large group	32,0	21.33
Hours small group	14,0	9.33
Self study	90,0	60.00
Hours medium group	14,0	9.33

Total learning time: 150 h

CONTENTS

1. Introduction to chemistry.

Description:

1.1 Pure substances and mixtures. Basic concepts. Solutions and concentration units.

1.2 Chemical reactions. Balancing. Stoichiometric calculations.

Related activities:

Theoric Classes, problems and practices.

Moodle questionnaires and evaluation tests.

Full-or-part-time: 39h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 7h

Self study : 26h

2. Atomic structure. Periodic table of elements.

Description:

2.1 Particles and atomic models.

2.2 Wave behavior of matter: De Broglie principle. Heisenberg uncertainty principle. Schrödinger equation. Orbitals.

2.3 Polyelectronic atoms. Periodic table. Periodic properties.

Related activities:

Activities 1-6

Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 1h

Self study : 8h

3. Molecular structure.

Description:

3.1 Chemical bond: covalent, covalent polar, ionic and metallic.

3.2 Lewis dot Formulas.

3.3 Bond theories.

Valence shell electron pair repulsion (VSEPR) Theory. Molecular geometry. Polarity of molecules. Intermolecular forces.

Valence bond (VB) theory.

Molecular orbital theory (MO).

Related activities:

Activities 1-6.

Full-or-part-time: 16h

Theory classes: 6h

Practical classes: 1h

Self study : 9h

4. States of matter.

Description:

4.1 Gases. Empirical laws. Kinetic-molecular theory. Real gases, Van der Waals equation.

4.2 Condensed states: Liquids and solids. Properties of liquids Solids: types and properties.

Related activities:

Activities 1-6.

Full-or-part-time: 20h

Theory classes: 6h

Practical classes: 2h

Self study : 12h



5. Chemical kinetics. Chemical equilibrium.

Description:

5.1 The rate of a Reaction. The rate-law expression. Molecular interpretation: collision theory of reaction rates. Transition state theory. Factors that affect in reaction rate. Reaction mechanisms.

5.2 Chemical equilibrium. The Equilibrium constants. Factors that affect equilibria.

5.3 Equilibria in solution: Acids and bases. Precipitation and solubility.

Related activities:

Activities 1-6.

Full-or-part-time: 39h

Theory classes: 7h

Practical classes: 5h

Laboratory classes: 7h

Self study : 20h

6. Electrochemistry.

Description:

6.1 Voltaic or galvanic cells. Standard electrode potential and cell potential. The Nernst equation. Corrosion of metals.

6.2 Electrolysis. Quantitative aspects of electrolysis: Faraday's Laws.

Related activities:

Activities 1-6.

Full-or-part-time: 16h

Theory classes: 4h

Practical classes: 2h

Self study : 10h

7. Organic chemistry.

Description:

7.1 Hydrocarbons. Functional groups. Isomerism.

7.2 Some reactions in organic chemistry.

Related activities:

Activities 1-6.

Full-or-part-time: 8h

Theory classes: 2h

Practical classes: 1h

Self study : 5h

ACTIVITIES

ACTIVITY 1. THEORY SESSIONS.

Description:

Large Group Methodology

Presentation of the contents of the subject, participatory exhibition class.

Material:

Basic and specific bibliography.

Material generated by teachers (Athena)

Delivery:

This activity is evaluated, like activity 2, with the completion of two written tests: PARTIAL EXAM (activity 4) and FINAL EXAM (activity 5) following the programming of l'ESEIAAT as well as with the realization of moodle questionnaires.

Full-or-part-time: 68h

Self study: 42h

Theory classes: 26h

ACTIVITY 2. PROBLEM SESSIONS

Description:

Medium Group Methodology

From each chapter, the teaching staff proposes to the students a series of questions, exercises and problems that they must solve. During the classes, some of the exercises and doubts that have been presented will be solved by discussing the different approaches or solutions.

Specific objectives:

At the end of these classes the students must be able to apply the theoretical knowledge of the subject to the application of practical cases. Also, and from the point of view of problem-solving methodology, students must be able to:

- Analyze the problem: understand the statement and be layers of answering questions such as what data do they give us? what is being asked for?
- Develop a plan to solve the problem: consider the possible paths according to the information that is given and what is requested. Determine the principles and relationships that unite the data with the unknown.
- Solve the problem: know how to use known information and relationships to isolate the unknown(s). Follow rules and instructions about signs, units, and significant figures.
- Check the solution: see if the answer is logical and reasonable. Check if both the units and the number of significant figures are correct.

Material:

Basic and specific bibliography.

Teacher notes (Athena)

Delivery:

This activity is evaluated, like activity 1, with the completion of two written tests: PARTIAL EXAM (activity 4) and FINAL EXAM (activity 5) following the programming of l'ESEIAAT as well as with the realization of Moodle questionnaires.

Full-or-part-time: 35h

Self study: 21h

Practical classes: 14h

ACTIVITY 3. LABORATORY

Specific objectives:

At the end of this activity the student must be able to:

- Perform basic chemistry laboratory operations.
- Recognize basic laboratory material and instruments.
- Acquire experimental skills
- Know how to describe the experiments carried out
- Know how to treat experimental data and draw conclusions
- Learn how to report on experimental work
- Know and use the basic standards of safety in a laboratory and waste management.

Material:

All the material and reagents necessary for the realization of the experiments in the laboratory.

Detailed script with the questionnaire and the report model that the student must deliver to the teacher of each practice.

Notes of the topics related to the practices (powerPoint) in ATENEA.

Videos with basic laboratory procedures.

Delivery:

For each of the practices:

- Pre-laboratory questionnaires.
- Reports or questionnaires of each practice.
- Final evaluation: written test on contents and methodologies of the practices, will be carried out either the last week of classes or in the schedule of the final exam.

Full-or-part-time: 32h

Self study: 18h

Laboratory classes: 14h

ACTIVITY 4. MIDTERM EXAM

Specific objectives:

Evaluate the knowledge acquired in the theoretical, practical and laboratory sessions.

Delivery:

The student must solve questions and problems on the exam sheets. The grade of this activity is the N1P of the overall grade of the subject.

Full-or-part-time: 3h

Theory classes: 3h

ACTIVITY 5: FINAL EXAM

Specific objectives:

Evaluate the knowledge acquired in the theoretical, practical and laboratory sessions.

Delivery:

Examination that must be resolved on the sheets distributed at the beginning of the test.

The grade of this activity is that of the N2P element of the overall evaluation of the subject.

Full-or-part-time: 3h

Theory classes: 3h



ACTIVITY 6. Moodle Questionnaires.

Description:

Moodle questionnaires for the evaluation and learning of the contents of the different topics.

Material:

MS PowerPoint presentations, collection of problems.

Delivery:

Moodle questionnaires (10% global qualification)

Full-or-part-time: 9h

Self study: 9h

GRADING SYSTEM

Note global (NG) = $0,20 \times N1P + 0,50 \times N2F + 0,20 \times NL + 0,10 \times NA6$

N1P First midterm exam

N2F Final exam

NL: Laboratory practices. Activity 3 of this guide

NA6: Guided activity 6

in case of failure of the midterm exam N1P, there will be the chance to recover it in the following way:

$NG^* = 0,70 \times N2F + 0,20 \times NL + 0,10 \times NA6$, if $N2F > N1P$

BIBLIOGRAPHY

Basic:

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- Atkins, P. W.; Jones, Loretta. Principios de química: los caminos del descubrimiento. 5a ed. Madrid: Médica Panamericana, 2012. ISBN 9789500602822.
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- Flaqué Lajara, C. [et al.]. Química per a l'enginyeria. 4ª ed. Barcelona: Iniciativa Digital Politècnica, Publicacions Acadèmiques UPC, 2018. ISBN 9788498807325 (en línia) 9788498807318 (imprès).
- Whitten, Kenneth W. Química general. 8a ed. Madrid: Paraninfo, 2010. ISBN 978-970-686-768-8.
- Sales i Cabré, Joaquim; Vilarrasa i Llorens, Jaume. Introducció a la nomenclatura química: inorgànica i orgànica [on line]. 5a ed. Barcelona: Reverté, 2003 [Consultation: 25/07/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=13554. ISBN 8429175512.

RESOURCES

Audiovisual material:

- <https://zonavideo.upc.edu/>. Resource



Hyperlink:

- <http://www.webelements.com/> - <http://www.periodicvideos.com/#>