Universidad Zaragoza

Academic Year/course: 2021/22

30102 - Chemistry

Syllabus Information

Academic Year: 2021/22
Subject: 30102 - Chemistry
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
179 - Centro Universitario de la Defensa - Zaragoza
Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
563 - Bachelor's Degree in Industrial Organisational Engineering
ECTS: 6.0
Year: 1
Semester: 425 - First semester
563 - Second semester
Subject Type: Basic Education
Module:

1. General information

1.1. Aims of the course

The aim of the subject is the acquisition of a basic view of the structure of matter in connection to its properties and the chemical transformations that matter can undergo.

1.2. Context and importance of this course in the degree

The achievement of the competences that are pursued with this course will allow the student to address simple practical cases related to Chemistry that may arise in their profession. In addition, the combination of the competences acquired in this subject, together with the rest of the basic training of the degree, will provide future graduates with the knowledge necessary to deal with complex cases in which different course may converge.

DEFENSE PROFILE

This subject contributes to the training of Army Officers, helping their maturity, as well as the acquisition of knowledge and skills necessary in the future development of the missions ordered to them throughout their professional life.

1.3. Recommendations to take this course

The usual ones to access the studies of any Engineering degree, basically the choice of the scientific-technological area in the Sixth Form. It is recommended to have acquired the competences of the Chemistry subject of, at least, one year in that level.

2. Learning goals

2.1. Competences

Ability to solve problems and take decisions with initiative, creativity and critical reasoning.

Ability to continue learning and develop self-learning strategies.

Ability to understand and apply the basic principles of general chemistry, organic and inorganic chemistry and its applications for engineering.

2.2. Learning goals

The student, to pass this subject, should demonstrate the following results ?

Knows the basic concepts of the structure of matter and relates them to their fundamental properties.

In a transversal way, he uses and interprets the language applied to chemical compounds and transformations.

Solve issues and problems of General Chemistry.

It uses adequate basic laboratory equipment to perform simple chemical experiments.

He interprets and presents contents from basic scientific texts related to Engineering, .

2.3. Importance of learning goals

This subject is included in the basic training module of the degree which, in a broad sense, aims to unify the knowledge of students and prepare them to address more specific subjects of the degree. In this sense, together with the rest of the basic subjects, the subject Chemistry contributes to lay the basis of a scientific model and, in addition, to equip future graduates with the necessary tools to approach other disciplines of the degree that need chemical concepts. Finally, the graduate will know and will be able to use the basic tools of Chemistry that will allow him to develop the professional competences related to this subject.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

BUSINESS PROFILE

The assessment process will include two types of action:

- ***A split assessment system,*** which will be carried out throughout the course and which will include:

Carrying out practice tasks in the laboratory.

Carrying out one or more works on practical aspects of the course.

Carrying out partial tests that can assess the knowledge acquired.

- ***A global assessment test*** to be carried out if the continuous assessment process has not been successful.

SPLIT ASSESSMENT SYSTEM

In order to be eligible for this assessment system, the student must attend class regularly, with at least 80% attendance in classroom activities (classes, practice tasks, technical visits, etc.). In the split assessment system, the teacher will assess the participation and works derived from laboratory practice tasks or others. Finally, the student must take several written tests that show the knowledge acquired and the ability to solve practical problems. The criteria of Assessment to be applied will be as follows:

Laboratory practice tasks and assignments:

It will account for 10% of the final grade and will be carried out according to the assessment of problems, questions or assignments related to the practices carried out in the laboratory or to other topics specific to the course that might appear, requiring at least a 5 in this section in order to pass the course. If the practical course could not be carried out, it would be replaced by the completion of a job, which would score in the same measure.

Partial assessment tests:

There will be two partial tests. Each of them will have a theory and practice load of approximately 50% each. This part will account for 90% of the final grade and to be able to pass it, it is necessary to have passed the two tests or, having passed one of them, to have a mark not lower than 3.

Students who, not having passed the previous criteria, might have a failed partial test must go to the final global exam to pass the missing parts.

GLOBAL FINAL ASSESSMENT TEST

This test must be seated by those students who have not chosen the split assessment system or those who, having opted for such a system, were not successful. The latter should only go in for the missing partial tests.

Students who, having passed the split assessment system, wish to increase their grade may also take this test. In this case, they should complete the whole test.

The test will be written and will consist of specific or applied to practical questions and problems theory. The theory and practice load will be approximately 50% each. In addition, to pass the course, you must have completed the practical activities and passed the corresponding project (or, failing that, the work to be carried out if the practicals could not be carried out).

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First call

Continuous assessment

- Test 1(T1). Solving problems of units 1, 2 and 3 (30% of the final mark). Minimum mark to pass the subject 4 out of 10.
- Test 2 (T2). Theoretical-practical test of the entire syllabus including practices (70% of the final grade). Minimum mark to pass the subject 4 out of 10.

To pass the subject, the student?s final grade must be equal to or greater than 5 out of 10.

Global test

Students who have not passed the continuous evaluation or who want to improve their grade may take the global test, with the best of their grades prevailing. The global test contains two parts: Test 1 (T1) and Test 2 (T2).

- Test 1. Solving problems of units 1, 2 and 3 (30% of the final mark). Minimum mark to pass the subject 4 out of 10.
- Test 2. Theoretical-practical test of the entire syllabus including practices (70% of the final grade). Minimum mark to pass the subject 4 out of 10.

To pass the subject, the student?s final grade must be equal to or greater than 5 out of 10.

Second call

Global test. The global test contains two parts: Test 1 (T1) and Test 2 (T2).

- Test 1. Solving problems of units 1, 2 and 3 (30% of the final mark). Minimum mark to pass the subject 4 out of 10.
- Test 2. Theoretical-practical test of the entire syllabus including practices (70% of the final grade). Minimum mark to pass the subject 4 out of 10.

To pass the subject, the student's final grade must be equal to or greater than 5 out of 10.

If the grade for Test 1 (T1) and/or the grade for Test 2 (T2) are less than 4, the student does not pass the course and their

final grade is calculated as follows:

If T1 < 4 and T2 < 5 N = 0,30·T1 + 0,70·T2

If T1 < 4 and T2 > 5 N = 0,30·T1 + 3,5

If T1 < 5 and T2 < 4 N = 0,30·T1 + 0,70·T2

If T1 > 5 and T2 < 4 N = 1,5 + 0,70·T2

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

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The organization of teaching will be carried out using the following steps:

- Lectures: Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.

- Practice Sessions: The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.

- **Laboratory Workshop**: The lecture group is divided up into various groups, according to the number of registered students, but never with more than 16 students, in order to make up smaller sized groups.

- **Individual Tutorials**: Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

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In order to get the objectives described in the previous sections the following learning activities will be carried out: lectures, practical and problem solving sessions, laboratory sessions.

In both specializations, if classroom teaching were not posssible due to health reasons, it would be carried out on-line.

4.2. Learning tasks

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The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	**Weekly school hours**
Lectures	2
Laboratory Workshop	2
Other Activities	6

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1. lectures,
2. practical and problem-solving sessions,
3. laboratory sessions.

4.3. Syllabus

The course will address the following topics:

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THEORETICAL CONTENTS

Module	Contents

1. THE ATOM AND THE PERIODIC SYSTEM	Topic 1.- **The atom.** Elemental particles. Atomic models. The Bohr atom. The quantum mechanical model. Atomic orbitals; quantum numbers. Principles for the electronic construction of atoms. Topic 2.- **General overview of the periodic table** Description of the current periodic table: groups and periods. Study of the electron shell and the periodic system. Periodic properties.
2. THE CHEMICAL BOND	Topic 3**.- The ionic bond** General characteristics of the ionic bond. Network energy. General properties of ionic compounds. Topic 4**.- The covalent bond** Simplified model: the Lewis theory. Bond polarity and geometry. Valence bond theory. Orbital hybridization. Molecular orbital theory. Topic 5**.- The metallic bond** General characteristics of metals. Theories of the metallic bond: the electron sea theory and valence bond theory. Alloys: classes.
3. BONDS BETWEEN MOLECULES	Topic 6**.- Intermolecular bonds** Van der Waal forces. Hydrogen bonds.
4. AGGREGATION STATES	Topic 7**.- The gas state** General characteristics of gases. Laws that govern the gas state. Equations of state. Kinetic theory. Gas mixtures: Dalton's Law. Gas diffusion and effusion: Graham's Law. Real gases: The Van der Waal equation. Topic 8**.- The liquid state** General characteristics of liquids. Vapour pressure. The effect of temperature on vapour pressure. Critical phenomena. Condensation of vapours and gases. Solidification. Topic 9**.- The solid state** Characteristics of solids. Classes of crystal network. Classes of solids based on bonding type. The phase rule and the triple point.
5. INTRODUCTION TO THE STUDY OF SOLUTIONS	Topic 10**.- Introduction to the study of solutions** Disperse systems. Types of solutions. Means of expressing concentration. Solid-in-liquid solutions. Liquid-in-liquid solutions. Gas-in-liquid solutions. Colligative properties of solutions. Colloidal solutions.
6. INTRODUCTION TO THE STUDY OF REACTIONS	Topic 11**.- Chemical equilibrium** The concept of reaction rate. Reversible and irreversible reactions. Chemical equilibrium: the equilibrium constant. Le Chatelier's principle. Stable, unstable and metastable systems. Topic 12.- **Neutralisation reactions** The acid-base concept. Aqueous solutions: pH of aqueous solutions. Acid-base strengths. Equilibrium constants. Salt hydrolysis.
7. ORGANIC	Topic 13**.- Organic chemistry**

CHEMISTRY	The properties of carbon. Types of organic substances Isomers. Organic chemical reactions. Polymers

PRACTICAL CONTENTS

Practical 1	**Standards in Chemical Laboratory** *Techniques, Equipment and Safety*
Practical 2	**Solution Preparation** *Na_2CO_3 0,1 M from Na_2CO_3 solid; $CaCl_2$ 0,1 M from $CaCl_2$ 2 M*
Practical 3	**Filtration** *Gravity Filtration and Vacuum Filtration*
Practical 4	***Volumetric Analysis*** *Water hardness; carbonates and bicarbonates in water.*
Practical 5	**Distillation**

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Contents

Unit 1. Chemistry and matter
1.1. Basic concepts
1.2. Fundamental laws of chemical reactions. Atoms
1.3. Compounds and chemical formula
1.4. Composition of compounds
1.5. Mixtures, solutions and solubility

Unit 2. Chemical reactions and stoichiometry
2.1. Chemical reaction and chemical equation
2.2. Stoichiometry of chemical reactions
2.3. Gases
2.3. Aqueous reactions
Lab. session 1: Preparation of Lead(II) Iodide.

Unit 3. Chemical equilibrium
3.1. Basic concepts
3.2. Equilibrium constant and chemical equation
3.3. Numerical importance of the equilibrium constant
3.4. The reaction quotient, Q
3.5. Le Chatêlier's principle
3.6. Acid-base equilibria and the pH scale

Unit 4. Energy and Chemistry
4.1. Basic concepts
4.2. The First Law of Thermodynamics: heat, work and enthalpy
4.3. Spontaneous processes
4.4. Entropy.
4.6. The Second Law of Thermodynamics.

Unit 5. Chemical kinetics
5.1. Reaction rates
5.2. Concentration and reaction rate
5.3. Rate laws
5.4. The change of concentration with time.
5.5. Temperature and reaction rate
5.6. Reaction mechanisms
5.7. Catalysis
Lab. session 2: The aluminothermic reaction

Unit 6. Atomic models
6.1. From classical physics to quantum mechanics
6.2. Line spectra and the Bohr model
6.3. The wave behaviour of matter
6.4. Quantum mechanics and atomic orbitals
6.5. Many-electron atoms
6.6. Electronic configurations and the Periodic Table
6.7. Periodic properties

Unit 7. Chemical bond I
7.1. Chemical bonds, Lewis symbols and the octet rule
7.2. Ionic bonding
7.3. Covalent bonding
7.4. Strength of covalent bonds

Unit 8. Chemical bond II
8.1. The VSEPR model
8.2. Molecular polarity
8.3. Molecular-orbital model
8.4. Molecular-orbital model for metals

Unit 9. Intermolecular forces and liquids
9.1. Intermolecular forces
9.2. Solubility and the solution process
9.3. Phases, phase changes and phase diagrams
9.4. Liquids: boiling point, vapor pressure, surface tension, viscosity

Unit 10. Solids
10.1. Amorphous solids and the short-range order. Glass transition temperature
10.2. Crystalline solids, the long-range order and the unit cell
10.3. Bonding in solids

Unit 11. Materials
11.1. Materials science and classes of materials
11.2. Ceramics
11.3. Polymers
11.4. Alloys
11.5. Semiconductors

4.4. Course planning and calendar

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SECTION	Topic	Nº hours
0 y 1	Presentation. Atom *(Topic 1)* and the Periodic System *(Topic 2)*	10
2 y 3	The Chemical Bond *(Topics 3, 4 y5)* and Intermoleculars *Bonds(Topic 6)*	12
4	Aggregation Sates *(Topics 7, 8 y 9)*	6
5	Introduction to the study of solutions *(Topic 10)*	8
6	Introduction to the study of reactions *(Topics 11 y 12)*	8
7	Organic Chemistry (Topic 13)	4
	Practical Course	6
	Exams	6
TOTAL		60

The dates of the final exams will be those that are officially published at
http://www.eupla.unizar.es/asuntos-academicos/examenes

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Before the start of the semester the course additional information will be published in the Moodle platform, which can be consulted at http://moodle.unizar.es after authentication with the student?s username and password.

This information will include the course planning, materials, bibliography and other recommendations to follow the course.

Information about general course calendars and timetables can also be found at the website of the Centro Universitario de la Defensa: http://cud.unizar.es.

4.5. Bibliography and recommended resources

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http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30102

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RESOURCES AND MATERIAL

Power Point Slides: The subject is presented with the help of Power Point software. The pdf files related to each of the topics will be available to students on the Moodle platform (https://moodle.unizar.es/)

Chemical Nomenclature:

- Principles

- Test

Material related to the Laboratory practices:

- Introduction to the work in lab.

- Theoretical and experimental abstracts of practices.

Audio-visual Material:

. Videos to illustrate different aspects of the subject syllabus.

Bibliography:

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30102

Any other additional material used will be deposited in the Moodle platform.