Universidad Zaragoza

Year : 2020/21

25200 - Chemical foundations of the environment

Syllabus Information

Academic Year: 2020/21
Subject: 25200 - Chemical foundations of the environment
Faculty / School: 201 - Escuela Politécnica Superior
Degree: 571 - Degree in Environmental Sciences
ECTS: 6.0
Year: 1
Semester: First Four-month period
Subject Type: Basic Education
Module: ---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

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

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, seminars and laboratory sessions.

All the proposed activities in this subject are focused on the understanding and assimilation of the chemistry principles to understand the different chemical processes that occur in the environment. Topics explained in lectures will be complemented in laboratory sessions.

A group work will be proposed at the beginning of the course, which will involve the discussion of a proposed topic in collaboration with Fundaments of Geology. Such topic will be closely related to contents included in both subjects: Chemistry and Geology. Also, individualized tutoring will monitor the learning process development.

4.2.Learning tasks

This course is organized as follows:

- **Lectures and seminars**. Students will receive the content of each lecture as well as the collection of numerical exercises at the beginning of each session.
- **Laboratory sessions**. These laboratory sessions will take 2 hours, approximately every 15 days. Students will have the content before the session, which includes the practical procedure and the theoretical contents.
- **Group work**. During the course students will be divided in groups of 4-5 members in order to develop a particular topic in collaboration with Fundamentals of Geology for the study of the environment. The proposed topic will be

closely related to contents included in both subjects: Chemistry and Geology. All the students are encouraged to submit an individual report previous to the final group presentation, which will include a summary with the different sections of the topic in addition to the corresponding bibliography.

4.3.Syllabus

This course will address the following topics:

Lectures

- **Section 1: Atomic Structure**

1. Atoms and atomic theory.
2. The components of the atom.
3. Introduction to the Periodic Table of Elements.
4. Relationships of mass in chemistry: atomic mass, mole, empirical formula.
5. Stoichiometry.

- **Section 2: State of Matter and Solutions**

1. Gaseous State: Gas Properties. Laws of gases, ideal gas equations. Kinetic-molecular theory. Equation of real gases.
2. Solid State: Types of solids. Van der Waals forces. Crystal structures.
3. Liquid State: Liquids Properties. Liquid-vapour balance. Changes of state. Phase diagrams.
4. Solutions: Units of Concentration. The basic fundamentals of solubility. Colligative properties.

- **Section 3: Thermodynamic and Kinetic**

1. Principles of heat transfer.
2. The First Principal of Thermodynamics.
3. Enthalpy. Thermodynamic equations.
4. Reaction rates.
5. Rate equations and integration of simple reaction orders
6. Half-life of reactants
7. Temperature and rated of reaction
8. Arrhenius equation. Activation energy.
9. Catalysis.

- **Section 4: Chemical Equilibrium**

1. Equilibrium. Basic concepts of equilibrium. Constant of Equilibrium. Changes in the conditions of equilibrium.
2. Acid-Base equilibrium: Definition of acid and base. Ionic product of water. pH and pOH. Strength of acids and bases. Buffer solution. pH indicators. Acid-base titration.
3. Redox equilibrium: voltaic cells. Standard Potential. Relation between E^o, K y DG^o. Electrolytic and commercial cells.
4. Precipitation equilibrium: constant of the product of solubility. Dissolving precipitates. Equilibrium of complex ions.

- **Section 5: Carbon Compound**

1. Introduction to hydrocarbons: Alcanes, alkenes, alkynes.
2. Functional organic groups.

Laboratory sessions

- **Session 1.** Production and behaviour of gases. Production of hydrogen. Determination of atomic weight of a metal.
- **Session 2.** Liquids and solutions. Concentration of solutions. Strong and weak electrolytes. Preparation of different solutions (sulphuric acid, hydrochloric acid, nitric acid, acetic acid, ammonium hydroxide and sodium hydroxide) to distinguish the behaviour of strong and weak electrolytes by measuring the pH.

- **Session 3.** Liquid solutions. Separation by destilation. Destilation of a commercial wine. Determination of alcoholic grade
- **Session 4.** Acids and Bases. Proton transfer reactions. Balances in solutions. Indicators. Recognize the behaviour of various indicators in different aqueous media: acid, basic and neutral. Study the acid-base behaviour of different salts depending on the colour they take on in the presence of an indicator. The study of different chemical equilibria.
- **Session 5.** Acid bases reactions. Neutralization. The study of a neutralization process by stage. Acid-base titration.
- **Session 6.** Oxidazing and reducing agents. Electron transfer reactions. Reaction of metals with the H+ ion (non oxidant acids) and with oxidant acids. Displacement reactions.
- **Session 7**. Chemical behaviour of alkaline earth metals and chemical behaviour of anions. Precipitation. Determination of an unknown salt

4.4.Course planning and calendar

Activity Type / Week	1 14-18 Sep 14 lectures start (Wed)	2 21-25 Sep	3 28 Sep-2 Oct	4 5-9 Oct	5 12-16 Oct Holiday 12 y 13 (Mon y Tue)	6 19-23 Oct (1)	7 26-30 Oc
Face-to-face activity							
Theory	2	2	2	2	2	2	2
Exercises/ seminars		2		2	2		
Lab. demonstra_tions						2	2
Trabajos en grupo							
Tutoring ECTS							
Evaluation							
Non-face-to-face activity							
Personal work	6	4	5	3	5	4	5
Group work			2	2		1	
TOTAL	8	8	9	9	9	9	9

lab. demonst.

holiday	[1]Wednesday October 21, 2020, Monday sch
exam period	[2]Thursday November 19, 2020, Tuesday sch
Lecturing period	From 14 September, 2020, to 13 January 2021
Evaluation period	From 14 January 2021 to 6 February 2021
	From 2 to 14 September 2021

Key dates and milestones of the subject. It is recommended to consult the schedule and calendar
The course has been structured in 19 school day. These include the Christmas holiday period and the examination period.

- Theory classes will begin in September with the beginning of the Academic Period.
- Problem solving will start during week 2.
- The laboratory demonstrations with consist of a total of 7 two-hour sessions, and will begin in week 6
- During the 3rd week, the group work topic will be introduced to the students together with the necessary guidelines for its development in coordination with the Geology course, setting the date for the revision and presentation of the individual and group scripts.
- The first formulation test will take place during week 11.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website and Moodle (http://moodle.unizar.es/).

4.5.Bibliography and recommended resources

Basic bibliography

1. Chang, Raymond. *Química*. Traduc. Erika Jasso Hernán D' Bourneville. 10ª ed. México: McGraw-Hill, 2010.

1. Kotz, John C. *Química y reactividad química*. Traduc. Mª. Teresa Aguilar Ortega. 5ª ed. México: Thomson, 2003.

1. Petrucci, Ralph, Harwood, William y Herring Geoffrey. Química general. Traduc. Concepción Pardo y Nerea Iza. 8ª ed. Madrid: Prentice Hall, 2003.

1. Brown, Theodore y Woodward, Patrick. *Química: la ciencia central*. Traduc. Laura Fernández. 11ª ed. México: Pearson Educación, 2009.
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Complementary bibliography

1. Huheey, James, Keiter, Ellen, Keiter, Richard. Química inorgánica: principios de estructura y reactividad. Traduc. María Teresa Aguilar. 4a. ed. México: Oxford University Press, 2001.
1. Manahan, Stanley. Environmental chemistry. 8th ed. Boca Raton: CRC, 2005.
1. Manahan, Stanley. Fundamentals of environmental chemistry. 2nd ed. Boca Raton: Lewis Publishers, 2001.
1. Peterson, W. R. Formulación y nomenclatura química inorgánica. 16ª ed.

Barcelona: Edunsa, 1996.

1. Peterson, W.R. Formulación y nomenclatura química orgánica. 15a. ed. Barcelona: Edunsa, 1993.

The updated recommended bibliography can be consulted in:
http://psfunizar10.unizar.es/br13/egAsignaturas.php?id=10963