Universitat Autònoma de Barcelona

2018/2019

Chemical Balance and Instrumentation

Code: 102846
ECTS Credits: 9

Degree	Type	Year	Semester
2501915 Environmental Sciences	OB	2	1

Contact

Name: Maria del Mar Puyol Bosch
Email: MariaDelMar.Puyol@uab.cat

Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Jordi Gené Torrabadella

Prerequisites

It is recommended to have knowledge of basic inorganic formulation (from high school level).

It is highly recommended to have understood and know how to put into practice the chemical equilibrium part of the Chemistry subject of the 1st year.

Objectives and Contextualisation

The subject of Chemical Equilibria and Instrumentation is part of the Chemical Matter for Environmental Sciences. It is a basic subject in order to be able to understand the fundamentals of most environmental problems, mainly in water media, as well as in order to recognize the methods of analysis of the different problems. Its main objectives are the following:

- Know the most relevant chemical basis about the different systems in aqueous equilibrium and their application and consequences for the environment.
- Acquire basic knowledge of the classical and current techniques used in the analysis of the main environmental compounds.
- Develop the necessary skylls to solve problems of chemical equilibrium and instrumentation related to environmental cases.
- Develop the necessary skylls to work in a laboratory.

Skills

- Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
- Analyze and use information critically.
- Collect, analyze and represent data and observations, both qualitative and quantitative, using secure adequate classroom, field and laboratory techniques

- Demonstrate adequate knowledge and use the most relevant environmental tools and concepts of biology, geology, chemistry, physics and chemical engineering.
- Demonstrate concern for quality and praxis.
- Demonstrate initiative and adapt to new situations and problems.
- Learn and apply in practice the knowledge acquired and to solve problems.
- Quickly apply the knowledge and skills in the various fields involved in environmental issues, providing innovative proposals.
- Teaming developing personal values regarding social skills and teamwork.
- Work autonomously

Learning outcomes

1. Adequately convey information verbally, written and graphic, including the use of new communication and information technologies.
2. Analyze and use information critically.
3. Apply chemical knowledge to solve problems in a quantitative or qualitative nature relating to the environment.
4. Demonstrate concern for quality and praxis.
5. Demonstrate initiative and adapt to new situations and problems.
6. Develop work type chemical analysis from previously established procedures.
7. Handle tools and equipment in chemical laboratories standards of environmental control.
8. Identify the chemical processes in the surrounding environment and evaluate them properly and originally.
9. Interpret data from databases or by experimental measures, including the use of computer tools, identify the meaning and relate behavior in environmental systems.
10. Learn and apply in practice the knowledge acquired and to solve problems.
11. Observe, recognize, analyze, measure, and so properly and safely represent chemical processes applied to environmental sciences.
12. Recognize and analyze chemical problems and plan appropriate responses or work for resolution, including, where necessary, the use of bibliographical sources.
13. Safe handling of chemicals, taking into account their physical and chemical properties.
14. Teaming developing personal values regarding social skills and teamwork.
15. Work autonomously

Content

I. Acid-base equilibria

Unit 1.- Chemistry of water and the environment. Acids and bases according to Brönsted and Lowry. Self-ionization of water. Definition of pH. Electrolytes Relative force of an acid-base pair: constant of acidity and basicity. Prediction of acid-base reactions: applications.

Unit 2.- Calculation of the pH of an acid or a base. Solubility of gases in water: pH of rainwater and acid rain. pH Buffer solutions; definition and pH determinations. Preparation and properties of a buffer solution. The buffer system of H_2CO_3/ HCO_3^-. Control of pH in chlorinated waters. Control of pH in chlorinated waters. Calculation of the pH of salts.

Unit 3.- Introduction to volumetric analysis techniques. Evaluations of acids or bases; titration curves, point of equivalence and end point. Acid-base indicators Calculation of the pH of a solution of monohydrogen carbonate ions (bicarbonate). CO_2 / Carbonate systems: pH of seawater and other natural waters. Alkalinity and acidity of water.

II. Balances of solubility and complexation

Unit 4. - Calcareous waters; Solubility and K_{PS} of $CaCO_3$. Variation of the solubility of $CaCO_3$ with the pH. Ionic concentration in natural waters. Solubility of $CaCO_3$ and "stability" of water; Langelier index (IL). IL, corals and microplankton. Methods for the determination of chlorides (salinity). Fractional precipitation.

Unit 5.- Complexes: Lewis acids and bases. Complexation equilibria. Complexation and acidity. Complexation assessments. Determination of water hardness. Complexation reactions in natural waters.

III. Oxidation-reduction balances

Unit 6.- Redox reactions: characteristics and definitions. Electrochemical batteries. Measure of the potential (f.e.m.) of a battery. Nerst equation. Standard electrode potential (Reduction potential). Prediction of a redox reaction. Equilibrium constant of a redox reaction.

Unit 7.- Redox titrations. Determination of COD; environmental significance. Store electricity. Commercial batteries.

IV. Instrumental methods of analysis applied to environmental samples

Unit 8.- Electrical methods. Potentiometric methods of analysis. Ion Selective Electrodes (ESI): determination of pH and other ions in aqueous solutions. Amperometric methods. Determination of dissolved oxygen (DO); Determination of BOD; environmental significance.

Unit 9.- Optical methods. UV-Vis; Determination of chlorine, application to recreational waters. IR spectroscopy; determination of OCD. Atomic Absorption (AA). Emission; FF and ICP.

Unit 10.- Methods of separation of environmental compounds. Gas chromatography (GC). Liquid chromatography (HPLC).

Methodology

The subject will be developed through theoretical or master classes, supported with additional material, classes of solving problems and laboratory practices.

In the classroom practices (problem solving) the students will develop some activities in a cooperative, others will be done individually and others will be done by teachers on the board.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Classroom practices	18	0.72	3, 10, 8, 9, 12, 14
Laboratory practices	21	0.84	4, 6, 7, 13, 11, 14
Master classes, supported by power point	50	2	8
Type: Supervised			
Tutoring	13	0.52	2, 5, 8, 1
Type: Autonomous			
Problem solving	36	1.44	3, 10, 8, 12, 15
Reading scripts (practices)	11	0.44	2, 5, 15

Study	49	1.96	2, 8, 11, 1, 15

Evaluation

- There will be two partial examinations whose value will be between 30% and 40% depending on the explained subject. The minimum mark of each partial to weight is 3.5.

- The examination of recovery can be of any of the partial exams or of the totality of the subject. In order to be able to do the examination of recovery of the totality of the subject, 2/3 of the continuous evaluation activities (partial and practical exams) must have been carried out.

- The minimum to consider the matter exceeded is 5.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Activity in the classroom	10%	5	0.2	2, 3, 10, 9, 12, 15, 14
Laboratory practices (60% exam, 40% reports)	20%	16	0.64	2, 10, 5, 4, 6, 9, 7, 13, 11, 1, 14
Written test (1st partial)	30-40%	3	0.12	2, 3, 10, 8, 11, 12, 1, 15
Written test (2nd partial)	30-40%	3	0.12	2, 3, 10, 8, 12, 15

Bibliography

1.-"Química General". Ralph Petrucci, Wiliam Harwood, Geoffrei Herring. Prentice-Hall (Pearson) 10a Edició, 2011. ISBN: 9788483226803

2.- V.L Snoeyink i D. Jenkins, Química del agua, Ed. Limusa, México, 1995.

3.- C. Baird, Química Ambiental, Ed.Reverté, (2001)

4.-"Equilibrios iónicos y sus aplicaciones analíticas" Manuel Silva, José Barbosa. Ed. SINTESIS, 2002. ISBN: 9788497560252