Universitat Autònoma de Barcelona

2020/2021

Chemical Reactivity

Code: 103292
ECTS Credits: 7

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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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

Other comments on languages

Exams can be taken in catalan or spanish

Teachers

Esteve Fábregas Martínez

Prerequisites

It is recommended that those students who have not studied Chemical subjects during the Bachelor attend the chemical courses, which the Faculty of Sciences organizes at the beginning of September.

Objectives and Contextualisation

The general objectives of the subject are to establish the fundamental concepts that allow understanding chemical reactions and to be able to relate them with other more specific subjects of the Degree of Nanoscience and Nanotechnology. These bases will allow the student to identify and apply the principles and their meaning to solve real world problems in a systematic and fast way and increase their critical and learning abilities.

The subject offers the students the fundamental principles of chemistry, their applications and qualitative and quantitative reasoning. Examples of the real world and more specifically of the field of Nanoscience will be given. The following areas will be emphasized: thermochemistry, homogeneous and heterogeneous equilibria, chemical kinetics, basic electrochemistry and organic chemistry.

Competences

- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.

- Apply the general standards for safety and operations in a laboratory and the specific regulations for the use of chemical and biological instruments, products and materials in consideration of their properties and the risks.
- Be ethically committed.
- Communicate orally and in writing in ones own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Handle the standard instruments and materials of physical, chemical and biological testing laboratories for the study and analysis of phenomena on a nanoscale.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Reason in a critical manner
- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Show sensitivity for environmental issues.
- Work on the synthesis, characterisation and study of the properties of materials on a nanoscale from previously established procedures.

Learning Outcomes

1. Apply the acquired chemistry theory to the explanation of experimental phenomena.
2. Be ethically committed.
3. Calculate cell potential for redox reactions.
4. Communicate orally and in writing in ones own language.
5. Correctly calculate the pH of aqueous dissolutions.
6. Correctly handle commonly used materials in a chemistry laboratory.
7. Correctly perform calculations in relation to chemical reactions (performance, limiting reagent, etc.)
8. Correctly use the protocols for manipulating reagents and chemical waste.
9. Correctly use the terminology of chemical compounds.
10. Critically evaluate experimental chemistry results and deduce their meaning
11. Describe basic chemical kinetics.
12. Describe the concept of solubility and the variables that affect it.
13. Describe the properties of the different aggregation states of matter, and relate these to chemical bonding and intermolecular forces.
14. Describe the three principles of thermodynamics and the associated thermodynamic functions.
15. Determine the velocity equation of an elementary process.
16. Identify reduction and oxidation processes in a redox reaction and the concepts of electrochemical cell, galvanic battery and electrolytic cell.
17. Identify the acid or base nature of chemical compounds in dissolution.
18. Learn autonomously.
19. Manage the organisation and planning of tasks.
20. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
21. Perform calculations related with solubility equilibrium and equilibrium constants.
22. Perform the basic synthesis, separation and analyses procedures of a chemistry laboratory.
23. Perform thermodynamic calculations of chemical processes.
24. Rationalise the results obtained in the laboratory in processes of synthesis, separation and analysis of chemical compounds on the basis of knowledge of their structure and properties.
25. Reason in a critical manner

26. Resolve problems and make decisions.
27. Show sensitivity for environmental issues.
28. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Content

-Thermochemistry. Reaction heat and calorimetry. Work-energy. First law of thermodynamics. Heats of reaction: ΔU and ΔH. Hess' Law. Standard enthalpies of formation. Calorimetric techniques.

- Principles of chemical equilibrium. Concept of chemical equilibrium, expressions and relationships between the equilibrium constants. The reaction quotient Q. Modifications of the equilibrium conditions: Le Châtelier's principle. Examples.

- Spontaneity and equilibrium. Spontaneity and Entropy. Second law of thermodynamics: Gibbs Energy. Relationship between Gibbs energy and equilibrium constant. Prediction of chemical change. ΔG^o and K_{eq} depending on the temperature.

- Introduction to chemical kinetics. Reaction rate and temperature. Rate measurement. Rate equations and order of reaction. Reaction rate and temperature. Catalysis.

- Acids and Bases (I). Review of Arrhenius theory. Bronsted-Lowry theory. Self-ionization of water and pH scale. Strong acids and strong bases. Weak acids and weak bases. Polyprotic acids. Ions as acids and bases. Lewis' acids and bases.

- Acids and Bases (II). Common ion effect in acid-base equilibria. Buffer solutions. Indicators. Neutralization reactions and titration curves. Polyprotic acid solutions. Calculations.

- Solubility and complexation. Solubility product and solubility. Common ion effect. Total and partial precipitation. Solubility and pH. Complexation equilibrium.

- Electrochemistry. Basic concepts: redox reactions. Electrode potential and standard electrode potential. Relationship between E, ΔG^o and K_{eq}. Energy variation with the concentration: Nernst equation. Batteries. Electrolysis. Corrosion.

- Organic Chemistry. Introduction to organic compounds and functional groups. Alkanes, alkenes and alkynes. Aldehydes and ketones. Carboxylic acids and esters. Amines

Methodology

DIRECTED ACTIVITIES

Theoretical Lessons	2-3/week	Theoretical lecturing
Exercises lessons	1/week	Exercises discussion and solving 2 groups
Laboratory practices	3 days 9-13h Compulsory:	Guided Laboratory practices 2 groups

	laboratory attendance, reports delivery and test	

To be able to do the laboratory practices you must keep the security forms up to date (via moodle). It is also mandatory to wear a lab coat and safety glasses (normal glasses will not be accepted).

SUPERVISED ACTIVITIES

Tutorials	once a week mariadelmar.puyol@uab.cat	Tutorials to help to assimilate theoretical concepts and to do the exercises

AUTONOMOUS ACTIVITIES

Study	Perform schemes and abstracts and assimilation of concepts
Exercises solving	Exercises approach and solving
Practical reports reading	Comprehensive reading of the laboratory reports
Practical reports writing	Laboratory reports writing in pairs

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Evaluation Activities	8.75	0.35	1, 3, 25, 21, 23, 26
Exercises lessons	17.5	0.7	18, 5, 15, 20, 25, 7, 21, 23, 26, 28, 9
Laboratory Practices	12.25	0.49	1, 18, 10, 4, 22, 6, 2, 27, 20, 24, 25, 26, 8, 9
Theoretical lectures	31.5	1.26	5, 3, 13, 12, 11, 14, 15, 17, 16, 2, 27, 25, 21, 23
Type: Supervised			
Tutorial meetings	17.5	0.7	1, 10, 4, 19, 2, 25, 26, 9
Type: Autonomous			
Exercises solving	29.75	1.19	1, 18, 5, 3, 15, 19, 20, 25, 7, 21, 23, 26, 9

Practical reports reading	1.75	0.07	1, 10, 6, 24, 28, 8, 9
Practices Reports writing	19.25	0.77	1, 10, 5, 4, 15, 20, 24, 25, 7, 21, 28, 9
Study	36.75	1.47	18, 13, 12, 11, 14, 19, 17, 16, 20, 25

Assessment

1. WRITTEN EXAMS

A) Partial: on the concepts of theory and problems. Minimum grade of 5 each exam to be able to average with the other activities

1st part (35% final note): Thermodynamics and Kinetic (Lessons 1-4)

2nd part (35% final note): Homogeneous and heterogeneous equilibria, Electrochemical and Organic chemistry (Lessons 5-9)

B) 2on chance exams: recovery of partial exams (35% final mark each) or global examination for unpassed partial exams (70% final mark).

In order to assist to these exams (partial or global) you must have attended a minimum of 2/3 of the continuous assessment activities and obtained a minimum mark of 3.5 in the partial exams.

You need a minimum mark of 5 of the final exam to average with other activities.

2. EVALUATION ACTIVITIES TO DELIVER (10%)

1. Delivery of problems and / or

2. Tests in the classroom and / or

2. Delivery of group work

3. PRACTICES (20%)

1. Practical reports (60%)

2. Test exam of the knowledge acquired during the practices (40%)

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st partial exam	35%	0	0	1, 10, 3, 13, 11, 14, 15, 25, 23, 28
2nd partial exam	35%	0	0	10, 5, 12, 17, 16, 7, 21, 28
Activities in the classroom to deliver in groups	10%	0	0	1, 18, 10, 4, 19, 2, 27, 20, 25, 26
Practices	20%	0	0	1, 10, 4, 15, 22, 19, 6, 2, 20, 24, 25, 26, 8, 9

Bibliography

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