Universitat Autònoma de Barcelona

2022/2023

Chemical Reactivity

Code: 103292
ECTS Credits: 7

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	FB	1	2

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 Fabregas Martinez

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 one's 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 one's 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

BLOCK I. Homogeneous and heterogeneous equilibrium

1. 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.

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

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

BLOCK II. Thermodynamics, kinetic and electrochemistry

4. 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.

5. 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.

6.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.

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

8. 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.

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 esteve.fabregas@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

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

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

The final grade of the subject is obtained from the exam notes, the continuous work of the student (learning evidences) and of the practices.

Average of the exams of the subject = 0.50 x note exam block I + 0.50 x note exam block II

Final mark of the course = 0.85 x average mark of the exams of the subject + 0.15 x note continuous work + 0.20 x note practices

To pass the subject, the following three conditions must be fulfilled:

1) The average of the exams of the subject should be $\geq$ 5.0

2) The mark of the examination of each block must be $\geq$ 3.0

3) The note of the practices should be $\geq$ 4.0

Students who do not pass the subject for failing to meet any of the above three conditions, regardless of whether the final grade is greater or equal to 5.0, they will obtain a maximum final grade of 4.5 considering- if the subject is suspended.

Continued work (10%):

1) Evidence of each student will be collected in each of the two blocks throughout the semester (problems solved individually or in groups, self-assessments on the virtual campus, short tests in class, tests, etc ...).

2) The note of the continuous work will be the average of the notes of the evidences collected throughout the course. The fact of not appearing to evidence implies a zero in that evidence.

Exams (70%):

1) An examination will be carried out at the end of each block (examination of block I and examination of block II).

2) At the end of the semester will be offered examinations of recovery of the two blocks (exams of second option).

- To participate in the recovery, the students must have been previously evaluated in a series of activities whose weight equals to a minimum of two thirds of the total grade ofthe subject.

- There is the possibility that students who do not need it will be presented to second-choice exams to improve the qualification of the course.

For all students to submit to these second-choice exams (recovery) or improvement), the block exam will be the one they get in this second option exam.

For all students to submit to these second-choice exams (improvement), the block exam will be:

- equal to that of the second option exam, if the note of the second option exam> course examination note,

- equal to the average of the block exam and the second option exam, if the note of the second option of the option < course exam notes.

Practices (20%):

The final mark of the practices will be calculated from the laboratory reports (60%) and the test exam of the knowledge acquired in the laboratory (40%).

Use unauthorized methods during one of the examinations of the subject (copy or communicate with a colleague, use of cell phones, use of smart clocks, etc ...) will be penalized with a "suspense" rating in the global course of the current course.

To attend an examination of any block it is essential to bring an identification document (ID or university card) with a recent and good quality photograph.

The qualification of "NOT EVALUABLE" will be obtained in the following cases:

- There is no note of laboratory practices (attendance to the classes of practices is compulsory).
- The student has not participated in any of the assessment activities of one of the blocks in which the subject is divided (exams and continuous work).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Block 1 (1st partial) exam	35%	0	0	1, 10, 3, 13, 11, 14, 15, 25, 23, 28
Block 2 (2nd partial) exam	35%	0	0	10, 5, 12, 17, 16, 7, 21, 28
Learning evidences	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

Textbook:

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

http://www.ingebook.com.are.uab.cat/ib/NPcd/IB_Escritorio_Visualizar?cod_primaria=1000193&libro=6751

Other support books:

- "Química", Raymond Chang, Kenneth A. Goldsby. 11a Edició. Editor MacGraw Hill, 2013. ISBN 978-6071509284

- "Principios de Química", P. Atkins i L. Jones, Médica Panamericana, 3ª edició, 2006. ISBN 950-06-0080-3

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

Software

None