Course guide
240713 - 240713 - Chemistry

Last modified: 05/07/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Almajano Pablos, Maria Pilar

Others: Primer quadrimestre:
MARIA PILAR ALMAJANO PABLOS - Grup: 10

TEACHING METHODOLOGY

Almost the entire course will use the methodology "Flipped Classroom" conjugated with various cooperative learning activities, mainly developed in the classroom.
There is a collection of videos selected from the internet and recorded at the UPC so that the student can have the expository class at the individual level, at home, with the distribution made by the lecturer. This will adapt to their learning rhythm and their previous knowledge, which tends to be very varied.
The visualization of each video will have a questionnaire with immediate feedback for the student, so you can know if you have assimilated what was intended. In the classroom doubts will be solved and various types of problems will be made, both individually and by team. The lecturer will always be supportive.
There will also be laboratory practices, which will assess instrumental objectives as well as writing content, oral and written expression (in the subsequent presentation that will take place in class).

LEARNING OBJECTIVES OF THE SUBJECT

Identify the main parts of the structure of the atom
Classify the elements of the periodic table
Balance the main chemical reactions
Establish the concepts of basic stoichiometry
Identify some everyday examples of solids and solutions, as well as their units of concentration
Differentiate between strong and weak electrolytes in water
Write the expression of the equilibrium constant of chemical reactions. Relate it to the reactivity and the factors that can have an influence.
Identify and describe the properties of inorganic and organic bonds. Apply it to its physical and chemical properties
Identify and formulate the main organic functional groups, as well as some of their most characteristic reactions
Use the equations corresponding to mass and charge balances
Calculate the concentrations of the different species in aqueous solution for reactions in acid-base equilibrium
Identify the redox reactions, as well as the oxidizing and reducing species, in everyday life.
Write correctly and balance the redox reactions and identify the species involved.
Calculate the potential (ε) redox reaction standards. Predict the reactivity of the compounds involved.
Distinguish between soluble and insoluble solids
Describe the solubility concepts of a solid and solubility product
Write correctly the expression of the solubility constant and relate it to the solubility
Predict whether a precipitate will form when mixing solutions
Calculate the solubility of solids in water and in the presence of a common ion and / or parallel reactions (acid-base and complexation)

STUDY LOAD

Type	Hours	Percentage
Hours small group	4,0	2.67
Hours large group	56,0	37.33
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Theoretical aspects of basic chemistry

Description:
Main parts of the structure of the atom
The periodic table
Main chemical reactions and their stoichiometry
Daily examples of solids and dissolutions with the units of concentration
Strong and weak electrolytes in water
Equilibrium constant of chemical reactions
Properties of inorganic and organic bonds. Relationship with chemical and physical characteristics
Hybridization and molecular structure.

Specific objectives:
Identify the main parts of the structure of the atom
Classify the elements of the periodic table
Balance the main chemical reactions
To establish the concepts of basic stoichiometry
Identify some everyday examples of solids and dissolutions, as well as their units of concentration
Differentiate between strong and weak electrolytes in water
Write the expression of the equilibrium constant of chemical reactions. Relate it to the reactivity and the factors that influence it.

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 27h
Theory classes: 10h
Guided activities: 4h
Self study : 13h

Aqueous acid-base equilibrium

Description:
General concepts. Strong and weak acids and bases
Balance calculations
Logarithmic diagrams
Monoprotic weak acids and bases
Polypolytic weak acids and bases
Protolite mixtures
Buffer solutions
Acids and bases most used in the industry

Specific objectives:
Use equations corresponding to mass and charge balances
Calculate the concentrations of the different species in aqueous solution in acid-base equilibrium
Apply the calculation of systems (acid-base) in examples of the environment and the chemical industry
Know the applications of the acids and bases most used in the industry

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 32h
Theory classes: 10h
Laboratory classes: 2h
Guided activities: 5h
Self study : 15h

Fundamentals of Carbon Chemistry

Description:
Main organic functional groups. Main reactions.

Specific objectives:
Identify and describe the properties of organic bonds. Relate it to its physical and chemical properties.
Identify and formulate the main organic functional groups as well as some of their most characteristic reactions.

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 32h
Theory classes: 13h 30m
Laboratory classes: 0h 30m
Guided activities: 3h
Self study : 15h

title english

Description:
Redox reactions, oxidizing and reducing species.
Balancing redox reactions. Species involved.
Calculation of the potential (ε) standards of redox reactions. Nernst's Equation.

Specific objectives:
Identify redox reactions, as well as oxidizing and reducing species, in everyday life situations.
Write correctly and balance redox reactions and identify the species involved.
Calculate the potential (ε) standards of redox reactions. Predict the reactivity of the compounds involved.
Apply the Nernst equation

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 22h
Theory classes: 10h
Laboratory classes: 1h
Guided activities: 2h
Self study : 9h

title english

Description:
Soluble and insoluble solids
Solubility and solubility product.
Formation of precipitates
Solubility in the presence of a common ion and / or parallel reactions

Specific objectives:
Distinguish between soluble and insoluble solids.
Describe the concepts of solid solubility and of the solubility product.
Write correctly the expression of the solubility constant and relate it to the solubility.
Predict if a precipitate will form when mixing solutions.
Calculate the solubility of solids in water and in the presence of a common ion and / or parallel reactions (acid-base and complexation).

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 1h
Guided activities: 3h
Self study : 14h

Complexes in solution

Description:
Work with complexes, their constants and their equations to analyze their possible applications

Specific objectives:
Write the terminology typical of the complexes, their applications and their balances
Solve systems in complexation equilibrium, considering general systematics through reactions, equilibrium constants and material balances.
Write correctly the expression of the degrees of formation of the existing complexes in solution

Related activities:
Self-learning videos with non-presential work
Questionnaires
Individual and team problems in the classroom
Written exercise of minimum contents

Full-or-part-time: 11h
Theory classes: 3h
Guided activities: 4h
Self study : 4h

GRADING SYSTEM

1. Continuous evaluation (2 individual exams in class): PAC 1 and PAC2
2. Partial exam: PA
3. Atenea tests, deliveries, portfoli, laboratory practice report : AT
4. Final exam: FI

FINAL MARK = 0.11 · PAC1 + 0.11 · PAC2 + 0.23 · PA + 0.1 · AT + 0.45 · FI

EXAMINATION RULES.

The continuous, partial and final evaluations must be carried out with the support of a simple calculator (not programmable) and the periodic table. For the rest of activities students can have documentation.

BIBLIOGRAPHY

Basic:
- Petrucci, Ralph H. General Chemistry : Principles and Modern Applications. 11th edition. Toronto: Pearson Academic, 2016. ISBN 9780132931281.
- Chang, Raymond ; Kenneth Goldsby. Chemistry. 12th edition. New York: Mc Graw Hill, 2017. ISBN 9789813151154.
- Karty, Joel. Organic Chemistry : Principles and Mechanisms. 2nd edition. New York: WW Norton & Co, 2019. ISBN 9780393663549.

Complementary:
- Harris, Daniel C; Charles A. Lucy. Quantitative chemical analysis. 9th ed. New York: W. H. Freeman, cop. 2016. ISBN 9781319154141.
- Rayner-Canham, Geoffrey; Overton, Tina. Descriptive inorganic chemistry. Sixth edition. New York: W.H. Freeman and Company, a Macmillan Higher Education Company, [2014]. ISBN 9781464125577.
- Bruice, Paula Yurkanis. Organic chemistry : study guide and solutions manual [on line]. Eighth edition, Global edition. Harlow, England: Pearson, [2017] [Consultation: 07/10/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5185922. ISBN 9781292160436.
- Sawyer, Clair N; McCarty, Perry L; Parkin, Gene F. Química para ingeniería ambiental. 4ª ed. Bogotá [etc.]: McGraw-Hill, cop. 2001. ISBN 9584101641.
- Herranz Agustín, Concepción. Química para la ingeniería. Vol 2. Barcelona: Edicions UPC, 2009. ISBN 9788498803921.

RESOURCES

Other resources:
Videos, material in Atenea, collections of problems, ...