Universidad Zaragoza

Year : 2019/20

26407 - Chemistry

Syllabus Information

Academic Year: 2019/20
Subject: 26407 - Chemistry
Faculty / School: 100 -

Degree: 296 - Degree in Geology
588 - Degree in Geology

ECTS: 6.0
Year: 588 - Degree in Geology: 1
296 - Degree in Geology: 1

Semester: First semester
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, laboratory sessions, problem-solving sessions, assessment tasks and autonomous work and study.

4.2.Learning tasks

This course is organized as follows:

- **Lectures** (4 ECTS: 40 hours). Interactive sessions in which the basics of chemistry will be learnt. Students will also acquire specific language of different topics in chemistry which will be helpful for the transmission of knowledge using specific vocabulary.
- **Laboratory sessions** (0.6 ECTS: 6 hours). Students will learn how to work properly in a chemistry laboratory and analyze and interpret laboratory data. Attendance is compulsory. Attitude, behaviour and skills displayed during the sessions will be taken into account in order to evaluate the student. Students will have to write laboratory reports.

- **Problem-solving sessions** (1.4 ECTS: 14 hours). Sessions of reduced groups in which students will learn how to properly use the nomenclature in chemistry and to solve basic chemistry problems.
- **Assessment tasks** (4 hours). Written exam about the topics covered in the lectures and a written exam of problems covered in the problem-solving sessions.
- **Autonomous work and study** (86 hours).
    - 52 hours to prepare the written test.
    - 10 hours for studying the Formulation and Nomenclature.
    - 18 hours to of problem-solving to prepare the written test.
    - 6 hours for preparing reports on laboratory work.

4.3.Syllabus

This course will address the following topics:

Lectures

Inorganic Chemistry Department: Topic 1-5 and 10.

Physical Chemistry Department: Topic 6-9 and 11-12.

- **Topic 1. The Origin of the elements. Nuclear reactions.**
  Introduction. The Nuclear Atom. Fundamental Particles: a Summary. Isotopy. The Concept of the Mole. Nuclear Stability. Nuclear Reactions and Artificially Induced Radioactivity. Nuclear Fission. Nuclear Fusion. Applications of Radioisotopes. Nucleogenesis of the Elements. Distribution of the Chemical Elements on the Earth.
- **Topic 2. External structure of atoms. The periodic table and Atomic properties.**
  Classifying the Elements: the Periodic Law and the Periodic Table. A Modern Periodic Table: the Long Form. Evolution of the Atomic Model. External Structure of Atoms. Atomic Orbitals. Multielectron Atoms. Effective Nuclear Charge. Orbital Energy Diagrams. Electron Configurations of the Elements. Atomic Properties: Atomic Radius. Ionization Energy. Electron Affinity. Electronegativity. Atomic Properties and the Periodic Table: a Summary.
- **Topic 3. Chemical bonding I. Molecular substances.**
  Chemical Bonding. Types of Substances According to Interactions between their Constituents. Lewis Theory. Covalent Bonding: an Introduction. Molecular Shapes: Valence Shell Electron Pair Repulsion (VSEPR) Theory. An Introduction to Valence Bond Theory. Bond Lengths and Bond Energies. Partial Ionic Character of Covalent Bonds. Polar and Nonpolar Molecules. Intermolecular Forces.
- **Topic 4. Chemical Bonding II. Non-molecular substances.**
  Non-molecular Covalent Substances: Structure and Properties. Non-molecular Ionic Substances. Ionic Bonding: an Introduction. Crystal Structures. Ionic Crystal Structures. Energetics of Ionic Bond Formation and Application to Properties: Melting and Boiling Points. Solubility. Partial Covalent Character of Ionic Bonds: Polarization. Non-molecular Metallic Substances. Metallic Bonding: Nature and Properties. Conductors, Semiconductors and Isolators.
- **Topic 5. Relationships involving atomic composition-chemical bonding-structure-properties.**
  Relationships between Atomic Composition and Bonding. Relationships between Bonding and Structure. Relationships between Structure and Properties. Study of Some Properties: Melting and Boiling Points. Solubility.
- **Topic 6. Thermodynamics: Introduction and general concepts.**
  The Laws of Thermodynamics. Thermochemistry. Gibbs Free Energy and Helmholtz Free Energy. Thermodynamic Tables. Thermodynamic Criteria for Equilibrium and Spontaneity.
- **Topic 7. Phase equilibria of pure substances.**
  Phase Rule. One Component Systems: Phase Diagrams of Pure Substances. Clapeyron Equation. Second-order Phase Transitions.
- **Topic 8. Multicomponent systems.**
  Different Concentration Scales. Chemical Potential. Liquid Solutions: Ideal Solution and Ideal Dilute Solution. Solubility of Gases in Liquids. Colligative Properties. Partition Equilibrium Constant. Electrolyte and Non-electrolyte Real Solutions: Activity Coefficients. Solid Solutions. Phase Diagrams.
- **Topic 9. Chemical Equilibrium.**
  The Thermodynamic Equilibrium Constant. Gas Phase Reactions. Reactions in Heterogeneous Systems. The Effect of Temperature and Pressure on the Equilibrium Constant. Displacement of Chemical Equilibrium: Le Chatelier's Principle.
- **Topic 10. Equilibria in aqueous solutions.**
  The Nature of the Aqueous Solutions. **Solubility Equilibria**. The Solubility Product Constant, Ksp. Relationship between Solubility and Ksp. Precipitation Reactions. Factors Affecting Solubility. **Acid-Base Equilibria**: a Brief

Introduction and Overview. Brønsted-Lowry Theory. Self-Ionization of Water. pH and pOH. Neutralization Reactions. Ions as Acids and Bases: pH of Salt Solutions. Acid-Base Equilibria of Carbonate Anion. **Oxidation-Reduction Equilibria**: an Introduction. Oxidizing and Reducing Agents. Balancing Redox Equations.

- **Topic 11. Electrochemical systems.**
  Definition of Mean Ionic Magnitudes. Electric Conductivity of Ionic Solutions. Equilibrium in Electrolyte Systems. Thermodynamics of Galvanic Cells: Nernst Equation. Standard Electrode Potential Table. Application of Potentiometric Measurements.
- **Topic 12. Chemical Kinetics.**
  The Reaction Rate and Rate Constant. Order of Reaction and Molecularity. Integrated Rate Laws for First, Second and n-Order Reaction. Mean Lifetime. Effect of the Temperature on the Rate Constant. Catalysis.

Problem-solving sessions:

Section I. Formulation and Nomenclature of Inorganic Chemistry

Section II. Resolution of numerical problems

- **Topic 1**. 1. Stoichiometry and composition
- **Topic 2**. Solutions
- **Topic 3**. Thermochemistry
- **Topic 4**. Phase Equilibria
- **Topic 5**. Chemical equilibrium
- **Topic 6**. Solubility and acid - base equilibria
- **Topic 7**. Oxidation-reduction equilibria.

Laboratory sessions:

- **Topic 1**. Introduction to laboratory work: Preparation of solutions of electrolytes and pH measurement
- **Topic 2**. Determination of equilibrium constants.

4.4.Course planning and calendar

The course consists of 40 lectures (3 - 4 lessons per topic) and 14 problem-solving sessions.

Two laboratory sessions (3 hour-long each) will be carried out. Elaboration of reports must be completed in 1-2 weeks.

The lectures will be held three days a week, while the problem- solving classes will be held one day a week throughout the semester. Two laboratory sessions will be held during the months of November and December (Tuesday or Wednesday). Several laboratory turns will be organized.

The start time and duration of the theoretical exam of each call will be placed at least one week in advance on the bulletin boards of the Areas of Physical Chemistry and Inorganic Chemistry.

Each call shall include the theory and problems written test, as well as a Formulation and Nomenclature test and a laboratory exam for those students who did not pass these topics during the semester.

Tutorials will be organized from the beginning of the academic year, taking into account the other educational activities.

For students enrolled in the course, classrooms and laboratories, the datesheet of lectures and practice sessionss will be published online via Bulletin Board advertisements on the platform Moodle at the University of Zaragoza, https://moodle2.unizar.es/add/.

Students will be distributed in groups for the laboratory sessions, which will be also published in Moodle, organized by the Coordinator of the Degree. The exam datesheet will be available at the Faculty of Science website https://ciencias.unizar.es/grado-en-geologia-0.

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 (https://ciencias.unizar.es; https://cienciastierra.unizar.es) and Moodle.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=26407&year=2019