Universidad Zaragoza

Year : 2020/21

27100 - General Chemistry

Syllabus Information

Academic Year: 2020/21
Subject: 27100 - General Chemistry
Faculty / School: 100 - Facultad de Ciencias
Degree: 446 - Degree in Biotechnology
ECTS: 12.0
Year: 1
Semester: Annual
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, practice sessions, autonomous work, study and assessment tasks.

Students are expected to participate actively in class throughout the semester.

Further information regarding the course will be provided on the first day of class.

See "Learning activities " and "Syllabus". More information will be provided on the first day of class.

4.2.Learning tasks

The teaching and evaluation activities shall be carried out in person unless, owing to the health situation, the provisions issued by the competent authorities and by the University of Zaragoza provide for them to be carried out in an online manner

The course includes the following learning tasks:

- Theory: 7 ECTS. Participative and interactive lectures.
- Numerical problems: 3 ECTS. Participative problem-solving sessions in groups with half of the students.
- Laboratory sessions: 2 ECTS. Laboratory sessions in reduced groups.
- Tutorials.

- Support academic training through the resources available in the moodle page of the course where the students can consult the following material.
    - Copy of the slides used in the lectures by the teacher, structured by topics.
    - Notebook of problems, structured by topics.
    - Notebook of nomenclature of inorganic compounds with examples
    - Notebook of nomenclature of organic compounds with examples
    - Selected didactical videos.

4.3.Syllabus

The course will address the following topics:

Topic 1. INTRODUCTION TO THE MODERN CHEMISTRY. The Scope of Chemistry. Properties, States and Classification of matter. Measure of Properties of the Matter. SI Units. Significant Figures. Uncertainties in Scientific Measurements.

Topic 2. ATOMS AND THE ATOMIC THEORY. Early Chemical Discoveries. Electron and other Discoveries: X-ray and Radioactivity. The Nuclear Atom. Chemical Elements. Determination of Atomic Mass. The Concept of the Mole and Molar Mass.

Topic 3. CHEMICAL COMPOUNDS. Types of Compounds and their Formulas. Structural Representation of Molecules. The Concept of the Mole and Chemical Compounds. Composition of Chemical Compounds. Oxidation States.

Topic 4. CHEMICAL REACTIONS AND STOICHIOMETRY. Chemical Reactions and the Chemical Equation. The Chemical Equation and the Stoichiometry. Chemical Reactions in Solutions. The Nature of Aqueus Solutions. Practical Aspects of the Stoichiometry.

Topic 5. CHEMICAL THERMODYNAMIC. Some Terminology. Heat. Work. The first Law of Thermodynamics. Heats of Reaction: DU and DH. Relationships involving DH. Standard Enthalpies of Formation. Sources and Uses of Energy. Spontaneity: the Meaning of Spontaneous Change. Spontaneity and Disorder: the Concept of Entropy. Criteria for Spontaneous Change: the Second Law of Thermodynamics. Evaluating Entropy and Entropy Changes. Standard Free Energy Change, DG^{o}. Free Energy Change and Equilibrium.

Topic 6. CHEMICAL KINETICS. The Rate of a Chemical Reaction. Measuring Reaction Rates: Concentrations as a Function of Time. Effect of Concentrations on Rates of Reactions: the Rate Law. Zero-order Reactions. First-order Reactions. Second-order Reactions. Reactions Kinetics: a Summary. Theories of Chemical Kinetics. Effect of Temperature on Reaction Rates. Reaction Mechanisms. Catalysis.

Topic 7. ELECTRONS IN ATOMS. Electromagnetic Radiation. Atomic Spectra. Quantum Theory: the Photoelectric Effect. The Bohr Atom: Ionization Energy of Hydrogen Atom. Wave-particle Duality. The Uncertainty Principle. Wave Mechanics. Quantum Numbers and Electron orbitals. Electron Spin: A Fourth Quantum Number. Multielectron Atoms. Nuclear Charge Effect. Shielding Effect. Orbital Energy Diagrams. Electron Configurations of the Elements and the Periodic Table.

Topic 8. THE PERIODIC TABLE AND ATOMIC PROPERTIES. Classifying the elements: the Periodic Law and the Periodic Table. A Modern Periodic Table: the Long Form. Metals and non-metals, Electron configurations of ions. Atomic Radius. Ionization Energy. Electron Affinity. Magnetic Properties. Atomic Properties and the Periodic Table: a Summary.

Topic 9. CHEMICAL BONDING I. BASIC CONCEPTS. Experimental Aspects of Chemical bonding. Lewis Theory: an Overview. Ionic Bonding: an Introduction. Crystal Structures. Ionic Crystal Structures. Energetics of Ionic Bond Formation. Covalent Bonding: an Introduction. Partial Ionic Character of Covalent Bonds. Electronegativity. Oxidation States. Partial Covalent Character of Ionic Bonds. Polarization. Covalent Lewis Structures. Resonance. Exceptions to the Octet Rule. Molecular Shapes. Valence Shell Electron Pair Repulsion (VSEPR) Theory. Bond Lengths and Bond Energies.

Topic 10. CHEMICAL BONDING II. ADDITIONAL ASPECTS. An Introduction to Valence Bond Theory. Hybridization of Atomic Orbitals. Multiple Covalent Bonds. An Introduction to Molecular Orbital Theory. Molecular Orbitals in Homonuclear Diatomic Molecules of the Second Period Elements. Delocalized Molecular Orbitals. Bonding in the Benzene Molecule. The Metallic bond. Structure of the Metals. Bonding in Metals: Band Theory.

Topic 11. SOLIDS. INTERMOLECULAR FORCES. RELATIONSHIPS INVOLVING ATOMIC COMPOSITION-BONDING-STRUCTURE-PROPERTIES. Comparison of the States of Matter. Types of Solids. Covalent Solids. Intermolecular Forces. Van der Waals Forces. Hydrogen Bonds. Relationships Between Atomic Composition and Chemical Bonding. Relationships Involving Atomic Composition-Chemical Bonding-Structure-Properties. Study of Some Properties: Melting and Boiling Points; Mechanic Properties; Solubility.

Topic 12. GASES. Properties of a Gas: the Concept of Pressure. The Simple Gas Laws. The Ideal Gas Equation: Applications. Mixtures of Gases. Nonideal (real) gases.

Topic 13. LIQUIDS. Properties of Liquids. Vaporization and Vapor Pressure. Transitions Involving Solids. Phase Diagrams. Water Properties.

Topic 14. SOLUTIONS. Type of Solutions: Some Terminology. Energetic of the Solution Process. Solution Concentration. Solution Formation and Equilibrium. Mixtures of liquids: ideal solutions and their Vapor Pressures. Liquid-vapor Equilibrium: Ideal Solutions. Solutions of Solids and Gases in Liquids: Ideal Dilute solution. Vapor Pressure of Ideal Dilute Solutions. Solubilities of Gases. Solutions of Solids in Liquids: Colligative Properties. Colloidal Mixtures.

Topic 15. PRINCIPLES OF CHEMICAL EQUILIBRIUM. The Equilibrium Constant Expression. Relationships Involving Equilibrium Constants. The Magnitude of an Equilibrium Constant. The Reaction Quotient, Q: Predicting The Direction of Net Change. Altering Equilibrium Conditions: Le Châtelier's Principle.

Topic 16. ACID-BASE EQUILIBRIA. Arrhenius Theory: A Brief Review. Brønsted-Lowry Theory of Acids and Bases. Lewis Acids and Bases. Self-Ionization of Water and the pH Scale. Strong Acids and Strong Bases. Weak Acids and Weak Bases. Polyprotic Acids. Molecular Structure and Acid-Base Behavior. Acid-Base Behavior of Organic Compounds. Acid-Base Equilibrium Calculations. Buffer Solutions

Topic 17. SOLUBILITY AND COMPLEX-ION EQUILIBRIA. Equilibria Involving Complex Ions. Complex-Ion Equilibrium Calculations. Solubility Product Constant, Ksp. Relationship Between Solubility and Ksp. Common-Ion Effect in Solubility Equilibria. Limitations of the Ksp Concept. Criteria for Precipitation and its Completeness. Precipitation Equilibrium calculations.

Topic 18. REDOX EQUILIBRIUM AND ELECTROCHEMISTRY. Redox Equilibrium. Nerst Equation. Redox Equilibrium Calculations. Electrode Potentials and their Measurement. Standard Electrode Potentials. E_{cell}, ?G, and K. E_{cell} as a

Function of Concentrations. Batteries: Producing Electricity Through Chemical Reactions. Corrosion: Unwanted Voltaic Cells. Electrolysis: Causing Nonspontaneous Reactions to Occur. Industrial Electrolysis Processes

Topic 19. PHYSICAL AND CHEMICAL PROPERTIES OF THE ELEMENTS. Elements: Classification of Metals, Non-metals and Semimetals. Structure: Polymorphs and Allotropes; Physical Properties. Chemical Properties: Standard Reduction Potentials, Oxidation States.

Topic 20. OBTAINING THE ELEMENTS. Metallic Elements: Natural State. Obtaining Metals, Metal Oxides Reduction (Ellingham Diagram), Carbon Reduction; Metalotermias; Electrolysis. Nonmetals: Natural State and Preparation of some Representative Elements.

Topic 21. STRUCTURE OF ORGANIC COMPOUNDS. Organic Compounds and Structures: An Overview. Alkanes. Cycloalkanes. Stereoisomerism in Organic Compounds. Isomerism cis/trans. Optic isomerism.

LABORATORY PRACTICE PROGRAM

- Security and basic laboratory work
- Concentration of solutions. Strong and weak electrolites.
- Equilibria in solution. Indicators. Acid-base reactions.
- Determining an equilibrium constant.
- Column chromatography. Separation of a mixture of dyes.
- Liquid-liquid extraction. Isolation of caffeine.

4.4.Course planning and calendar

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 Facultad de Filosofia y Letras website https://ciencias.unizar.es/grado-en-biotecnologia

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=27100&year=2019