Universidad Zaragoza

Academic Year/course: 2022/23

28902 - Chemistry I

Syllabus Information

Academic Year: 2022/23
Subject: 28902 - Chemistry I
Faculty / School: 201 - Escuela Politécnica Superior
Degree: 583 - Degree in Rural and Agri-Food Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject Type: Basic Education
Module:

1. General information

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

Theoretical sessions will basically consist of participative lectures.

Along with some practical sessions, focused on previously considered theoretical aspects of the program, students will be able to resolve some numerical exercises about applied concepts. This participation will be both at individual or reduced student groups level as well depending on the considered subject.

Laboratory sessions will introduce students to laboratory instruments and scientific methodologies as well as the corresponding experimental data treatment.

For each practice session, some detailed instruction manuscripts will be available for students with a detailed methodology to follow and some questions to be answered about the obtained results during experiments. A written formal report will be presented by students at the end of each laboratory session.

Finally, students will be arranged in working groups and some supervised works will be proposed by the teacher covering complementary aspects related to general chemistry not considered in ordinary class sessions. The process will be supervised by the teacher along with some meeting sessions carried out during the term. At the end of the process, a final formal written document must be presented by a student for its evaluation and a speech report with an essential part of the main work must be presented and evaluated as well.

4.2. Learning tasks

The course includes the following learning tasks:

1. Theoretical and practice sessions related with the subjects included in the program
2. Laboratory sessions which includes some of the classical experiments in the field of general chemistry.
3. Supervised Works on several subjects related to general chemistry

4.3. Syllabus

The course will address the following learning tasks:

Theory program

Section1. PRELIMINARY CONCEPTS

Topic 1. Formulation and nomenclature of inorganic chemistry.
Names and symbols of the elements. Oxidation number. Binary compounds. Acids. Salts and saline compounds. Addition compounds.

Topic 2. Stoichiometry and chemical equations.
Chemical equations. Limiting reagent. Yield. Stoichiometric calculations.

Section2. ESTADOS DE LA MATERIA

Topic 3. The gaseous state
Pressure and temperature in the changes in the state of matter. The gaseous state. The laws of gases. The ideal gases. Mixtures of gases and partial pressures. The real gases: deviations from ideal behavior of the gases. Cubic equations of state. Van der Waal?s equation.

Topic 4. The liquid state
Characteristics of the liquid state. Properties of liquids. Viscosity and surface tension. Vapour pressure.

Topic 5. The solid state
Characteristics of the solid state. Crystalline structure of solids. Changes of phase and energies associated with the distinct transitions between the states of matter. Phase diagrams.

Section3. THERMODYNAMICS AND CHEMICAL KINETICS

Topic 6. Thermodynamics.
Basic definitions: systems and variables of thermodynamic states. Internal energy: enthalpy and entropy. Principles of thermodynamics. Thermochemistry: Hess?s Law.

Topic 7. Thermodynamics applied to the study of systems of agricultural interest.
Thermodynamic properties of air. Dry air and humidity of the air. Vapour pressure and saturation pressure of humid air. Dew point temperature. Absolute, relative and specific humidities. Enthalpy of humid air. Psychrometric diagrams: Mollier?s and Carrier?s diagrams. Applications: heating and cooling of air. Humidification of air.

Topic 8. Chemical kinetics
Factors that influence the speed of a chemical reaction. Speed of chemical reactions. Equation of velocity and the integration of kinetic equations of simple orders. The half-life of a reagent. Temperature and speed of reaction. Arrhenius equation. Activation energy. Catalysis and catalysts.

Section4. SOLUTIONS AND EQUILIBRIUMS

Topic 9. Solutions
Expressions of concentration. Use of solutions in chemical reactions. Relation: temperature to solubility. Colligative properties. Colloids.

Topic 10. Chemical equilibrium
Homogeneous equilibrium. Heterogeneous equilibrium. Constants of equilibrium and related calculations. L' Chatelier?s Principle.

Topic 11. Acids and bases
The acid-base concept of Arrhenius. The acid-base concept of Bronsted. Acid-base properties of water. Ionic product of water. Concept of pH. Strong and weak electrolytes. Constants of ionization. Resolution of problems of ionization and pH. Acid-base properties of salts. Hydrolysis.

Topic 12. Acid-base equilibriums
Effect of the common ion. Buffer solution. Titrations. Indicators.

Topic 13. Equilibriums of Solubility.
Concept of solubility and modes of expressing it. Effect of the common ion on solubility. pH and solubility. Complexion equilibrium and solubility.

Topic 14. Redox equilibriums.
Redox reactions and equilibriums. The standard potential of the electrode. Electrochemical cells. Spontaneity in redox reactions
Batteries. Corrosion. Electrolysis

Laboratory Sessions

- Session 1. Determination of the hardness of the water.
- Session 2. The conductivity of electrolytes. Kohlraush?s Law.
- Session 3. Kinetics of a chemical reaction.
- Session 4. Solutions. Preparation of a solution. Concentration of solutions.
- Session 5. Distillation of commercial wine. Determination of the alcoholic content.
- Session 6. Acid-base equilibriums in solution. Indicators. Acid-base reactions.
- Session 7. Redox reactions. Oxidants and reducing agents. Electron transfer reactions. The reaction of metals with the H+ ion (non-oxidant acids) and with oxidant acids. Displacement reactions.

4.4. Course planning and calendar

It is estimated that an average student should dedicate a total of 150 hours to this subject, of 6 ECTS, which should include both face-to-face and non-face-to-face activities. The student should try to ensure that the dedication is spread evenly over the four-month period, at a rate of 8 hours per week (4 face-to-face and 4 non-face-to-face).

The general schedule is as follows:
- theory classes will begin in September with the start of the academic term.
- Problem solving will start during week 2.
- Laboratory practicals will consist of a total of 7 two-hour sessions, and will start in week 3.

- During the 3rd week, students will be presented with the group work topic and the necessary material to develop it in coordination with the Geology subject, setting the date for the revision and presentation of the individual and group scripts.
- The first formulation test will take place during week 11.

However, this schedule may be altered due to the existence of holidays, or other academic activities that may substitute or complete the scheduled ones.

4.5. Bibliography and recommended resources

BB Chang, Raymond. Química / Raymond Chang ; revisión técnica, Rodolfo Álvarez Manzo, Silvia Ponce López, Rosa Zugazagoitia Herranz ; [traducción, Erika Jasso Hernán D' Bourneville]. 10ª ed. México [etc.] : McGraw-Hill, cop. 2010

BB Química general : principios y aplicaciones modernas / Ralph H. Petrucci ... [et al.] ; traducción, Concepción Pando García-Pumarino, Nerea Iza Cabo ; revisión técnica, Juan A. Rodríguez Renuncio. 10ª ed. Madrid [etc.] : Prentice Hall : Person Educación, 2011

BB Whitten, Kenneth W. Química general / Kenneth W. Whitten, Raymond E. Davis, M. Larry Peck ; con la colaboración con ensayos de Ronald A. DeLorenzo, Middle Georgia College ; traducción, Eduardo Gayoso Andrade, José Manuel Vila Abad. 5ª ed., (3ª ed. en español). Madrid [etc.] : McGraw-Hill, D.L. 1998

BC Amigo Martín, Pablo. Termotecnia : aplicaciones agroindustriales / Pablo Amigo Martín. Madrid [etc.] : Mundi-Prensa, 2000

BC Brown, Theodore L. Química : La ciencia central / Theodore L. Brown, H. Eugene LeMay, Bruce E. Bursten ; traducción Héctor Javier Escalona y García, M. en C. Roberto Escalona ; Revisión técnica M. del Carmen Doria Serrano. 3a ed. en español. México [etc.] : Prentice-Hall Hispanoamericana, cop. 1998

BC Peterson, W. R. Formulación y nomenclatura química inorgánica : [según la normativa IUPAC] / W. R. Peterson. 16ª ed. Barcelona : Edunsa, 1996

The updated recommended bibliography can be consulted in:
http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28902