UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Theory and Methods of Spectroscopy

2526-1-FSM02Q041

Aims

The classroom lessons are structured to provide students with a solid and rigorous foundation in general chemistry, preparing them for more advanced studies in the discipline. The course focuses on mastering fundamental chemical concepts, with particular attention to the quantitative aspects of stoichiometry and the numerical interpretation of essential chemical principles.

By the end of the course, students will be able to:

- Demonstrate sufficient knowledge and understading of general chemistry principles.
- Apply stoichiometric methods and chemical theory to solve numerical problems.
- Critically analyze chemical concepts within a theoretical framework.
- Communicate chemical information clearly and effectively using appropriate scientific language.
- Develop autonomous learning skills to deepen their understanding of chemistry.

Contents

Matter. Atoms and atomic theory. Chemical compounds. Chemical reactions in aqueous solution. Redox reactions. Gases. Thermochemistry. Electrons in atoms. Periodic table. Chemical bonding. Intermolecular forces. Liquids. Solids and modern materials. Phase diagrams. Solutions. Chemical kinetics. Acid-base equilibria. Electrochemistry.

Detailed program

Matter: its properties and measurement, errors, significant figures.

Atoms and atomic theory.

Chemical compounds: formulas, moles, oxidation states, nomenclature.

Chemical reactions in aqueous solution: equations, types, and balancing.

Redox reactions.

Gases: gas laws, ideal gases, real gases, equations, kinetic-molecular theory, gas mixtures.

Thermochemistry: terminology, heat, enthalpy, enthalpy changes, Hess's law.

Electrons in atoms: basic concepts of quantum chemistry, atomic spectra, orbitals, atomic configurations.

Periodic table: groups, periods, periodicity of properties (ionization potential, electron affinity, electronegativity, and atomic radius).

Chemical bonding: covalent, polar covalent, ionic, metallic, VSEPR theory.

Intermolecular forces: van der Waals forces, hydrogen bonding, dipole-dipole forces, induced dipole forces.

Liquids: vapor pressure, boiling point.

Solids and modern materials: types of solids, crystal systems, cubic lattices, coordination, X-ray diffraction.

Phase diagrams.

Solutions: solubility, concentration, dilution.

Chemical kinetics: collision theory, rate constants, reaction order, Le Chatelier’s principle.

Acid-base equilibria: Arrhenius and Brønsted-Lowry theories, autoionization of water, strong and weak acids and bases, hydrolysis, buffer solutions.

Electrochemistry: batteries, standard potentials, hydrogen electrode, Nernst equation.

Prerequisites

Students should have a basic knowledge of mathematical operations.

Teaching form

16 lessons of 2 hours in person and 8 lessons of 2 hours in LEEL.

Textbook and teaching resource

“Chemistry: The Central Science” by Theodore L. Brown, H. Eugene LeMay, Bruce E. Bursten, Catherine J. Murphy, Patrick M. Woodward & Matthew W. Stoltzfus

“Chemistry: Principles and Reactions” by William L. Masterton & Cecile N. Hurley

"Inorganic Chemistry" by Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong

"Chemical Principles" by Peter Atkins, Loretta Jones, Leroy Laverman

Semester

2º semester

Assessment method

There are no mid-term or partial exams scheduled. The assessment of learning consists of a mandatory written exam and an optional oral exam at the end of the course.

Written exam: six questions (two stoichiometry problems and four open-ended questions on the topics of the program)

Students who want to try to improve their grade (up to a maximum of 10%) can take an oral exam.

Two additional points are awarded to students who correctly complete, and within the allotted time, the exercises assigned via Moodle at the end of the course.

Office hours

Professors are available by appointment for any clarifications on the topics covered in class.

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION