UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physical Chemistry II

2627-2-E2703Q008-E2703Q00801

Aims

The course aims to provide:

- knowledge and understanding of the kinetics of chemical reactions and of introductory elements of quantum chemistry, through lectures.

- ability to apply kinetic principles, through numerous examples presented in class and classroom exercises.

- independent judgment, through the analysis of kinetic problems and the discussion and selection of solutions.

- communication skills, through active participation in lectures and exercises and the oral exam.

- ability to learn, through the resumption and integration of the previous knowledge of mathematics, physics and chemistry, useful for the analysis of the structure, properties and chemical reactivity.

Contents

Chemical kinetics: Study of the rates of chemical reactions and rate laws. Reaction mechanisms. Temperature dependence. Catalysis.

Quantum chemistry: Introduction to quantum-mechanics. Applications of quantum chemistry to model systems, atoms and molecules.

Detailed program

Chemical kinetics:

- Rates of chemical reactions and rate laws. Kinetic experiments.
- Methods for determining the order of a reaction and the rate constant.
- Elementary stages and multi-stage mechanisms. Identification of the reaction mechanism.
- Reaction coordinate, transition state and activation parameters
- Arrhenius and Eyring equations.
- Catalysis; Michaelis Menten equation.

Quantum chemistry:

- Insufficiencies of classical physics for the study of microscopic systems. From classical mechanics to quantum mechanics.
- Application of quantum mechanics to model systems (single particle subjected to constrained translational, vibrational and rotational motions).
- Introduction to the application of quantum mechanics to the study of atomic structure (hydrogenoid systems and polyelectronic atoms).
- Introduction to the application of quantum mechanics to the study of molecular structure (diatomic molecules).

Prerequisites

Knowledge of general, inorganic and organic chemistry. Basic knowledge of mathematics.

There are no imposed propaedeutics, but it is recommended to have passed the first-year exams and the Physical Chemistry I exam.

Teaching form

Lessons, 7 credits: 25 two-hour lectures, in person, Delivered Didactics. Lectures are also video-recorded and made available on the e-learning page.

Exercises, 2 credits: 8 two-hour practical classes, in person, Interactive Teaching. Exercises are proposed to be solved in the classroom with the participation of the entire class.

Textbook and teaching resource

In the e-learning page of the course are provided: the slides presented during the lessons; some exercises with solutions for individual preparation for the written exam; the video-recorded lectures.

Recommended text: P. Atkins, J. de Paula, Physical Chemistry, 9?? edition

Semester

Second semester

Assessment method

The assessment of the Physical Chemistry II module consists in a written and an oral examinations. The two examinations can be taken separately.

The ***written examination*** concerns the solution of problems regarding the Chemical Kinetics and has the objective of verifying the acquired knowledge, the ability to apply this knowledge to the solution of problems, and the ability of judgement. The student who passes the written examination is admitted to the oral examination. The written examination is valid for 6 months.

The ***oral examination*** includes a brief discussion on the written test and an interview on all the topics covered in class (Kinetics and foundations of Quantum Chemistry). It aims to verify the knowledge and understanding of the exam program. The grade (18-30/30) is assigned on the basis of the following criteria:
18-21: knowledge and understanding of a part of the program topics, with limited ability to discuss, analyze and critically elaborate; 22-24: knowledge and understanding of the program topics, with sufficient ability to discuss and analyze them; 25-27: knowledge and understanding of the program topics, with good ability to discuss and critically analyze them; 28 – 30/30L: complete and exhaustive knowledge and understanding of the program topics, with excellent ability to discuss and critically analyze them, and to connect topics to each other and to other disciplines.

The final mark range (18-30/30) is obtained by integrating the evaluations of the written and oral examinations.

The final mark for the course "Physical Chemistry II and Laboratory" is calculated as the weighted average of the evaluations obtained in the two modules "Physical Chemistry II" and "Physical Chemistry Laboratory".

Office hours

Students reception in the office after e-mail appointment.

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY