UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Fondamenti Chimici di Modelli Ambientali

2627-2-F7503Q018

Aims

To treat the main physical-chemical aspects related to the equilibrium distribution of compounds in various environmental compartments and extend the thermodynamic discussion to the study of non-equilibrium systems, in order to use the knowledge gained for the treatment of environmental systems.

Laboratory experiences will integrate the arguments discussed during the course.

Knowledge and understanding At the end of the course the student knows:
- the thermodynamic quantities used for the description of partition equilibria of a compound between different phases and compartments;
- the equations describing the transport processes of matter, heat and momentum;
- the stability criteria of equilibrium states and stationary states, in a linear and non-linear regime.

Applying knowledge and understanding At the end of the course the student is able to:
- predict the spontaneous evolution of the systems involved in processes of distribution of a compound between different phases and compartments and calculate the distribution at equilibrium;
- calculate the spatial and temporal evolution of species following diffusion processes;
- calculate the stability of the steady state of a system that is in conditions of non-equilibrium.

Making judgements At the end of the course the student is able to:
- apply the thermodynamic description of equilibrium systems for the study partition processes;
- apply the thermodynamic description of non-equilibrium systems (in linear and non-linear regimes) for the study of transport processes and chemical reactivity.

Communication skills Knowing how to describe in a technical report in a clear and concise manner the objectives, the procedure and the results of the laboratory experiments performed. Knowing how to present orally the topics proposed by the teacher with language properties .

Learning skills To be able to apply the acquired knowledge to different contexts from those presented during the

course, and to understand the topics covered in the scientific literature concerning the thermodynamic aspects of the processes of interest.

Contents

Partitioning equilibria; Environmental thermodynamics; Transport processes

Detailed program

Thermodynamics aspects of partitioning processes. Real systems: fugacity and activity coefficients. Partitioning processes: vapour and liquid-gas distribution. Activity coefficients and solubility in water. Partitioning of compounds between different environmental compartments and phases.

Transport processes

Thermodynamics of non-equilibrium systems. Thermodynamic equilibrium and stability criteria. Non- equilibrium systems: the linear regime and the stationary states. Criteria for stability of stationary states. Systems far from equilibrium and stability criteria. Dissipative structures

Thermodynamic description of the processes that take place on the Earth pinatea

Prerequisites

Thermodynamic of equilibrium systems

Teaching form

The course includes 4 CFU (32 hours) of lectures and 2 CFU (20 hours) in the laboratory.
-) 16 two-hour lectures, in person, delivered frontaldidatics;
-) 5 four-hour lab activities, in person, Interactive Teaching. In the laboratory experiences are realized regarding topics covered during the lectures in order to better understand the phenomenological and theoretical aspects.

Textbook and teaching resource

Lecture notes of the teacher: U. Cosentino, Chimica Fisica Ambientale

Suggested textboks

P.W. Atkins, J. de Paula Physical Chemistry, 9a edition, 2011, Oxford University Press

Rene P. Schwarzenbach, R.P, Gschwend P.M., Imboden D.M., Environmental Organic Chemistry – 2003, second edition, Wiley

D. K. Kondepudi, I. Prigogine Modern Thermodynamics: From Heat Engines to Dissipative Structures, John Wiley & Sons Inc, 1998.

A. Kleidon, Thermodynamic Foundations of the Earth System, Cambridge University Press, 2016

Semester

First semester

Assessment method

The exam consists of a group presentation of a technical report on the laboratory experiments, followed by an individual oral exam.

The technical report is evaluated for completeness, accuracy, and clarity of presentation, and the grade is assigned based on the following criteria:
18-22: sufficient grade but with significant deficiencies in completeness, accuracy, and clarity of presentation;
23-25: fair grade with complete but not in-depth and accurate descriptions, with possible deficiencies in presentation;
26-27: distinguished grade with complete and accurate descriptions, presented correctly;
28-30/30L: excellent grade with complete and accurate descriptions and significant personal contributions in interpreting the results, presented clearly and comprehensively;

The individual oral exam covers a series of course topics selected by the students and agreed upon with the instructor and is designed to assess: the level of knowledge acquired; the student's independent analysis and judgment; and his or her presentation skills. The interview grade is assigned based on the following criteria:

18-22: sufficient preparation on the topics covered, with limited discussion and analysis skills that are developed only with the instructor's assistance and questions; presentation skills and vocabulary are not always correct, with limited critical thinking skills;
23-25: adequate preparation on the topics covered, with inconsistent independent analysis skills, use of correct vocabulary, though not entirely accurate and clear, and presentation skills that are at times uncertain;
26-27: solid preparation on the topics covered, with the ability to independently conduct argumentation and critical analysis, the ability to apply knowledge to contexts and connect themes to concrete cases, use of correct vocabulary, and proficiency in the use of disciplinary language;
28 – 30/30L: Complete and comprehensive preparation, ability to independently address and critically analyze topics, ability to reflect and self-reflect, and ability to connect topics to concrete cases and different contexts, excellent critical and independent thinking, full command of the disciplinary vocabulary, rigorous and detailed presentation skills, and ability to argue, reflect, and self-reflect.

The final grade, expressed out of thirtieths with possible honors, is the average of the two exams.
Upon student request, the exam may be taken in English.

Office hours

Every day, by appointment**.**

Sustainable Development Goals

CLIMATE ACTION