SH1008 Environmental Physics and Chemistry 9.0 credits

Miljöfysik och miljökemi

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for SH1008 valid from Autumn 2008

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Physics, Technology

Specific prerequisites

Recommended prerequisites are: Good knowledge of mathematics, physics and chemistry from college.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The course aims at repeating and developing basic knowledge of physics and chemistry. It also aims at highlighting how environmental problems can be addressed using methods and theories from physics, chemistry, and mathematics. The course, furthermore, aims at giving introductory knowledge of natural physical and chemical processes and their interactions, as well as their quantifications. Special focus is on elemental cycles. Furthermore, the course aims at indicating the environmental significance of humans (and especially engineers) as well as giving an introduction to practical methods for different types of sensors and for data monitoring and data handling within physics ("hands-on").

In the environmental physics part the students will have leant how matter and energy interacts and why this is relevant for different measurements in physics. In particular different measuring techniques (remote sensing, infrasound, etc) of monitoring our environment are discussed. Black body radiation, radioactivity, thermodynamics are other special topics relevant to the understanding of environmental physics and the students will have experienced the inherent features and their impact on environmental problems.

In the chemistry part of the course, you will refresh and deepen your basic knowledge in chemistry for use in environmental applications. The learning outcomes includes

1. To be able to describe the chemical composition (and the main elements' occurrence forms) of the geosphere, the atmosphere, the hydrosphere, and the biosphere and to explain how interactions between these spheres and the technosphere affects the environment;

2. To know how different types of chemical reactions affect the element cycles and transport in nature, including writing correct reaction formulas, classifying reactions and from a chemical formula distinguish the dominant form of binding (e.g. covalent or ionic) and, where relevant, predict the oxidation number of elements in a chemical compound and the shapes of molecules;

3. To be able to solve primarily inorganic environmental chemistry problems using chemical equilibrium, stoichiometry, and relations from the chemical thermodynamics;

4. To be able to describe the dominant features in the hydrological and the biogeochemical cycles and to make calculations for individual elements and draw conclusion with implications for the pollution situation and to account for the coupling to energy flows in nature;

5. To know the basic chemical features of some environmental concerns of today and their societal origin, with specific focus on acidification, eutrophication, ozone, nuclear wastes, heavy metals, organic pollutants, and climate change issues. Detailed aims for learning outcomes for each of these focus areas are formulated by co-operating student groups, but may typically include: to be able to exemplify the primary pollutants that cause the environmental problem of concern, and to point out the antropogenic source, to exemplify which chemical reactions/chemical properties of the substance that brings about the environmental problem and its potential treatment, and to account for the main aspects of the time evolution of the pollutant situation and future predictions;

6. To be able to on a basic, engineering level communicate orally as well as written within the field of environmental chemistry.

Course contents

The course focuses on element cycles and mass and energy balance laws, different types of radiation ant their environmental effects, as well as the on human impact on the environment. Different experimental and theoretical techniques from the physics are also briefly assessed. Important themes include:

- Matter, energy, exergy: Smallest parts, forces, interaction, elements, stability and radioactivity
- The environment in a large and narrow perspective: Our place in the universe, the third planet from the sun, space weather, meteorites, immediate and long term effects. Catastrophes and their impacts on the environment.
- Sensors and systems for monitoring: Remote sensing, satellites, multi-spectral analysis, infrasound.
- The greenhouse effect, the ozone layer: The atmosphere, composition and variations, global and local impacts, absorption and reflection
- Chemical compounds and reactions in nature: Chemical reactions, reaction formulas, basic principles of chemical bonding
- Quantitative aspects of environmental chemistry: reaction stoichiometry and chemical equilibrium applied in environmental chemistry
- Basic, chemical principles of thermodynamics: driving force for chemical reactions, energy exchange, intensity and capacity parameters
- Biogeochemical cycles: the spheres, biogeochemical dynamics, mass balances, human impact
- Basics of some current environmental problems: Eutrofication, acidification, heavy metals, organic pollutants, ozone, green house gases, nuclear wastes.
- Seeking information and references; writing reports

Course literature

Miljöfysik, Energi för Hållbar Utveckling av Mats Areskough (2006) Studentlitteratur

Kurskompendium i miljöfysik (available at Kursexp., AlbaNova, vlevel 5 and downloadable via bilda)

Luft, vatten, och Mark. Kompendium i Miljöskydd del 3 (1997)Available at studentexpeditionen vid Industriell Ekologi.

Miljöeffekter. Kompendium i Miljöskydd del 4 (1997) Brandt N., Gröndahl F.Available at Industriell Ekologi.

A collection of environmental chemistry papers.

Examination

- INL1 - Assignments, 1.5 credits, grading scale: A, B, C, D, E, FX, F

- PRO1 - Project, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- TENB - Examination, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- TENA - Examination, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 1.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Written exam in environmental physics (1,5 hp) and environmental chemistry (1,5 hp), home tasks in environmental chemistry (1,5 hp), project tasks in environmental physics (3 hp) and computer laboration/group work in environmental chemistry (1,5 hp).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.