Introduction to sustainable chemistry 2025

Main field: Sustainable Chemistry
Course code: KZ7012

Tentative Lecture and seminar schedule for HT 2025:
Period: HT 2025, period A; Monday, September 1 until Wednesday, October 1.

Week 1 (September 1-5)

1. ***Introduction to the course and general concepts; September 1, 9.15-12, C516***
   Introduction to the course, including the lecture and seminar schedule, course material, requirements and examination. Definitions of green chemistry and UN sustainability goals, sustainable chemistry concepts and systems thinking used in research and industrial practice.
   Lennart Bergström

2. ***Introduction to green chemistry, September 2, 9.15-12, C516***
   Overview of the history and current status of the field of green chemistry. Introduction to the 12 principles of green chemistry. Examples of how environmental problems created by chemical activities can be mitigated or eliminated by the combination of legislation, technical development and changes in consumer choices.
   Lennart Bergström

3. ***Green and sustainable chemistry, September 3, 9.15-12, C516***
   In depth description of the 12 principles of green chemistry with examples. Introduction of how hazard, risk, and life cycle assessments are performed, including both environmental and health aspects. Examples of sustainability assessments of industrial activities.
   Lennart Bergström

4. ***Anthropogenic global warming and the role of chemistry; September 4, 9.15-12, C516***
   Overview of anthropogenic causes of climate change and global warming and main sources of anthropogenic greenhouse gases and the sectors that contribute the most. Identify and outline underlying chemical processes for important greenhouse gas emissions and carbon sinks. Describe in detail the carbon footprint of important industrial activities, including cement and concrete, iron and steel, the chemical industry. Present and discuss various mitigation strategies for CO_2.
   Lennart Bergström

5. ***Planetary boundaries and systems thinking; September 5, 9.15-11, C516***
   Overview of systems thinking. Overview of the concept of planetary boundaries and a description of the nine boundaries. Connect the importance of chemistry to selected planetary boundaries, including novel entities.

Week 2 (September 8-12)

6. ***Life cycle assessment 1: Introduction to standardization of environmental sustainability and LCA; September 8, 9.15-12, C516***
   Introduction to standardization of environmental sustainability performance (ISO 14000 series). Introduction to life cycle assessment (LCA, ISO14040 and 14044), the four phases of LCA and the iterative approach.
   Joseph Samec

7. ***Life cycle assessment 2: Goal and Scope definition; September 9, 9.15-12, C516***
   The goal and scope definitions are fundamental to LCA and include the following aspects: The reasons for carrying the study; limitations with the study; the audience and commissioner; decision contexts: -attributional or consequential LCA. The system boundaries including the function, reference flow and the functional unit; reference and elementary flows. The scope of what to include and excluded in the study. Multifunctional aspects of a system: allocation.
   Joseph Samec

8. ***Renewable resources; September 10, 9.15-12, C516***
   Overview of renewable resources, materials and bio-refineries with identification of important drivers and challenges.
   Jiayin Yuan

9. ***Sustainable chemistry for renewable energy; September 11, 9.15-12, C516***
   Introduce how chemistry can enable new technologies to replace fossil fuels for energy production.
   Jiayin Yuan

Week 3 (September 15-19)

10. ***Life cycle assessment 3: Life cycle inventory analysis and impact assessment. September 15, 9.15-12, C516***
    Life cycle inventory (LCI), mass and energy balances of reference flow to fulfill the functional unit. Data quality: primary and secondary data. Normalizing reference flow to the functional unit. How to treat multifunctional aspects and recycling. Life cycle impact assessment (LCIA): how the reference flow result in elementary flows that affect the environment in selected impact categories such as climate change. Midpoint and endpoint categories and areas of protection. Interpretation will be covered.
    Joseph Samec

11. ***Circular economy and bioeconomy; September 16, 9.15-12, C516***
    Presentation of the current linear economy production mode and introduction of the circular economy concept and the bioeconomy concepts. History of circular economy, examples of current and potential circular economy products and value chains. Description of the main challenges to the transformation to a circular economy: Circular Economy in the EU, and future of circular economy. Introduction of the forest industrial processes and products including the biorefinery concept and examples of potential lignocellulose-based products.
    Lennart Bergström

12. ***Life cycle assessment 4: September 17, 9.15-12, C516***
    Joseph Samec

Sustainable chemistry seminar 1 (safe and sustainable by design)**: *September 15, 13:30-16:30 C516***
Lennart Bergström

LCA seminar 1: ***September 17, 13:30-16, C516***
Joseph Samec

LCA seminar 2: ***September 18, 13:30-16, C516***
Joseph Samec

Week 4 (September 22-26)

13. ***Chemical regulations in EU and globally. September 22, 9.15-12, C516***
    Overview of the main principles of environmental law applicable to chemicals, for example the precautionary principle. Major chemical regulations in the EU and influential global agreements on chemicals, e.g. REACH and Stockholm POPs Convention.
    Marlene Ågerstrand, ACES

14. ***Review and Q&A. September 25, 9.15-11, C516***
    Presentation of the recent EU Chemical strategy and the concept of Safe and Sustainable by design. Summary of previous lectures with possibility for questions and answers.
    Lennart Bergström

Sustainable Chemistry seminar 2 (focus on mitigation of GHG emissions): ***September 24, 13:30-16:30, C516***
Lennart Bergström

Self-study: ***September 23 and 26***

Week 5 (September 29-October 1)

Self-study: ***September 29-30***

Examination: ***Written exam: Wednesday, October 1 in room C516: 10:00-15:00***

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