Course Outline/Description
The course is jointly offered by the Department of Chemical Engineering and Applied Chemistry and School of the Environment. It deals with the behavior of chemicals, such as persistent organic pollutants (POPs), in the natural environment. We treat the natural environment as multimedia systems consisting of various compartments such as air, water, soil and biota. We apply chemical engineering principles such as transport phenomena and quantify the movement and changes of pollutants. Our goal is to convey an appreciation of the source, fate and effect of pollutants in the environment by analyzing various processes of transport and transformation of pollutants. Quantitative expressions of these processes are established for the evaluative environment—a much simplified representation of the real environment. The concept of fugacity is introduced as a simple and yet powerful tool for formulating various processes. Specific topics include "environmental chemicals", “multimedia partitioning”, “intermedia transport”, “environmental loss mechanisms” and “fugacity models”.

Learning objectives
To understand the behavior (fate, transport and effects) of pollutants in the natural environment, and to master a valuable tool for evaluating and predicting environmental behaviour of pollutants—the fugacity-based mass balance models (aka Mackay Models).

Course Reading

Grading
- Assignments (15%): A problem set is assigned on Blackboard approximately every other week (approximately 7 total). It is due one week after issue.
- Term project report and presentation (25%): Teams of 4-5 students will use the models studied in the course to assess the fate, transport, and effects of a chemical pollutant in a natural environment. The team will give an oral presentation and submit a report. More details will become available at the beginning of February.
- Final exam (60%): 2.5 hours, closed book, all non-programmable calculators allowed, 1 aid sheet
Course Content

1. Chemical Engineering Basics: Steady state, equilibrium, mass balances, residence times

2. Nature of the Environment:
   2.1 Atmosphere
   2.2 Climatology
   2.3 Hydrosphere
   2.4 Lithosphere

3. Environmental Chemicals: Physical properties, phase equilibrium and partitioning, chemical properties

4. Fugacity-based model level I: closed system, equilibrium models

5. Fugacity-based model level II: mass balance of open system

6. Fugacity-based model levels III and IV: intermedia transport, unsteady state systems

7. Applications of fugacity-based models