SC336

Environmental Contaminants

3 Credits

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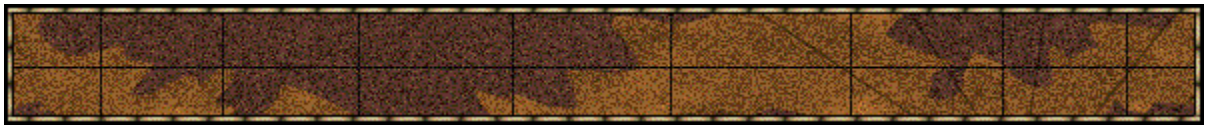

Environmental Contaminants

Calendar Description

This course focuses on study of Environmental contaminants, their physical- chemical properties and fate and transport in environmental media (air, water and soil). The focus is on industrial pollutants discharged into the environment from various sectors such as pulp and paper, oil and gas, mining and agricultural developments. Emphasis is placed on contaminant risk assessment and risk management. Students learn about emerging environmental contaminants and evolving engineering solutions to mitigate these contaminants.

Rationale

This course is a core requirement for students in the Applied Environmental Sciences major and the Environmental Conservation & Reclamation major of the Environmental Science diploma. The fate and transport of a pollutant depends on the properties and characteristics of the pollutant as well as the environmental media in which it is discharged. It is imperative for the environmental technician to understand the fundamentals of the movement of the pollutant in order to conduct environmental site assessments, identify and apply appropriate federal and provincial guidelines, assess risks to humans and the environment, and mitigate those risks.

Prerequisites

SC110, SC200 and SC301

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. identify, assess and manage point and non-point sources of chemicals to the environment.
2. predict the movement of chemicals between source emissions and environmental media (air, surface water, sediment, groundwater, soil).
3. develop a Conceptual Site model which identified pollutant sources, exposure pathways, and receptors.

4. interpret analytical data sets for chemicals in various environmental media.
5. assess risks to humans and the environment from exposure to environmental chemicals.
6. assess the physical, chemical and biochemical behavior that influence the movement, retention and transformation of pollutants in soils, water and air.
7. describe the fate and transport of organic and inorganic pollutants in soils, surface water, sediment, groundwater and air.
8. explain and describe physio-chemical properties of environmental pollutants.
9. explain impacts of pollutants upon organisms and ecosystems.
10. solve practical quantitative problems dealing with chemical fate and transport.
11. describe mass balance and control volume.
12. explain fugacity and equilibrium partitioning among all phases.
13. explain abiotic and biotic chemical transformation in subsurface.
14. describe chemical equilibrium, chemical kinetics, and partition coefficients.
15. collect, organize, interpret and report statistical data from various lab experiments

Essential Employability Skills

Essential employability skills are critical for workplace success and lifelong learning. Lakeland College prepares its graduates for the workplace and lifelong learning by integrating and promoting essential employability skills development in its curricula. Each credit course offered at Lakeland College emphasizes one or more of the following five essential employability skills:

A. **Communication Skills** that enable individuals to listen, interpret, express, and convey knowledge and ideas so that they are received and understood.

B. **Teamwork Skills** that enable individuals to respect the thoughts and opinions of others as they work together to plan activities, meet deadlines, complete projects, and contribute to an organization's goals.

C. **Critical Thinking Skills** that enable individuals to conceptualize and analyze issues from various perspectives while rationally evaluating the strengths and limitations of each perspective and deciding what action to take.

D. **Adaptability Skills** that enable individuals to respond quickly, willingly, and positively to new conditions and changing times.

E. **Positive Attitude and Behavioural Skills** that enable individuals to be confident about themselves and to deal with people, problems, and situations with honesty, integrity, and personal ethics.

Resource Materials

***Required Text*:**
There is no required textbook for this course.

***Reference Text*:**

Hemond, H.F., and E.J. Fechner-Levy. 2000. Chemical fate and transport in the environment. 2nd ed. Academic Press, San Diego, California.

http://www.library.ualberta.ca/permalink/opac/5963085/LAKELND_LLWEB

Eisler, R. 2007. Eisler's encyclopedia of environmentally hazardous priority chemicals. Elsevier.

BOEHNKE, N. 2000. Laboratory experiments in environmental chemistry.

Dunnivant, F.M., and E. Anders. 2006. A basic introduction to pollutant fate and transport: an integrated approach with chemistry, modeling, risk assessment, and environmental legislation. John Wiley & Sons.

Brusseau, M.L., Pepper, I.L., & Gerba, C.P. 2019. Environmental and pollution science. 3rd ed. Academic Press. https://catalogue.neoslibraries.ca/catalog/8588531?lib=lakeland

Conduct of Course

This course consists of 38 hours of lecture and 24 hours of lab work.

The lecture is a formalized classroom situation where the instructor discusses pertinent topics and students are expected to take notes. Student questions are encouraged to clarify subject material.

The lab component is intended to reinforce the subject material discussed in class. It is composed of exercises and assignments to be completed during and after the dedicated lab time, field trips and/or guest lecturer. The lab component provides practical application of the theory related to the fate, transport and risks of environmental contaminants.

Evaluation Procedures

The final mark consists of:

Lab/assignments	20%
Midterm exam	35%
Final exam	40%
Subjective Grade (attendance, enthusiasm, participation, attitude)	5%
Total	100%

Lab and assignment due dates are discussed in class. Late lab and assignments are **NOT** accepted and receive a grade of zero.

Knowledge/Skills Matrix

Students apply and demonstrate their knowledge and skills to use

A. Communication Skills

A1. by listening, reading, interpreting information, and communicating effectively	
	Evaluation(s)/Goal(s): Midterm and Final Exam/Goals 1 - 15; Labs and Assignments/Goal 7 - 12
	& 15
A2. by using written, spoken, and/or visual formats and media to communicate and meet needs	
	of each particular audience
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15
A3. by using libraries, Internet, technical publications, journals and other sources to find	
	pertinent information
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15

B. Teamwork Skills

B1. by using interpersonal skills to create an atmosphere that maximizes the strengths of group members to	
	accomplish tasks
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15 - 15
B2. by using interpersonal skills to resolve conflict, relate to others, and assist others	
	Evaluation(s)/Goal(s): N/A
B3. by contributing and listening to others as group determines realistic objectives, prioritizes tasks, and	
	identifies resources and timelines
	Evaluation(s)/Goal(s): N/A
B4. by treating other members of the group open-mindedly and fairly	
	Evaluation(s)/Goal(s): N/A
B5. by developing tactics/strategies to accomplish tasks	
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15

C. Critical Thinking Skills

C1. by seeing critical thinking as a lifelong process of self-assessment	
	Evaluation(s)/Goal(s): Midterm and Final Exam/Goals 1 - 15; Labs and Assignments/Goal 7 - 12 & 15
C2. by examining problems closely	
	Evaluation(s)/Goal(s): Midterm and Final Exam/Goals 1 - 15
C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts	
	Evaluation(s)/Goal(s): N/A
C4. by seeking out the truth	
	Evaluation(s)/Goal(s): N/A

C5. by finding solutions; make decisions	
	Evaluation(s)/Goal(s): N/A
C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic	
	Evaluation(s)/Goal(s): Midterm and Final Exam/Goals 1 - 15; Labs and Assignments/Goal 7 - 12 & 15
C7. by seeing connections between topics and use knowledge from other disciplines to enhance reading and learning experiences	
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15

D. Adaptability Skills

D1. by working independently or as part of team	
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15
D2. by carrying out multiple tasks or projects	
	Evaluation(s)/Goal(s): N/A
D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done	
	Evaluation(s)/Goal(s): N/A
D4. by being open and respond constructively to change and uncertainty	
	Evaluation(s)/Goal(s): N/A

E. Positive Attitude and Behavioural Skills

E1. by dealing with people, problems, and situations with honesty, integrity, and personal ethics	
	Evaluation(s)/Goal(s): N/A
E2. by showing interest, initiative, and effort	
	Evaluation(s)/Goal(s): Labs and Assignments/Goal 7 - 12 & 15
E3. by affirming the need for positive solutions and encourage positive interaction and feedback	
	Evaluation(s)/Goal(s): N/A
E4. by balancing personal and family activities with job-related activities	
	Evaluation(s)/Goal(s): N/A

Grade Equivalents and Course Pass Requirements

A minimum grade of D (50%) (1.00) is required to pass this course.

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.

Attendance

Classroom and laboratory attendance is considered vital to the learning process and as significant to the students' evaluation as examinations and reports, therefore absenteeism is recorded.

a. Students having a combination of excused and/or unexcused absence of 20 percent or higher for the scheduled course hours can be required to withdraw and would then automatically receive a "RW" (required withdrawal) for the course, regardless of any other evaluation results. (RW is a failing grade).
b. An excused absence is one that is verified with your instructor. Verification should be prior to the absence or the next class day following the absence. Verification of the absence may take the form of a note from your doctor/College nurse regarding illness, or a note from another instructor regarding a field trip or other activity, or authorization by your instructor following an in-person meeting. Be sure to contact your instructor and ask what they will require from you as verification for each absence. An unexcused absence is anything NOT verified by the instructor prior to the absence or the next class day following the absence.

NOTE: Any exceptions to the above attendance policy (e.g. timetable conflicts, work-related issues) must be approved in writing by the Department Chair prior to the beginning of the course.

It is the students' responsibility to know their own absentee record.

Normal hours are 8:30 a.m. to 6:30 p.m., with potential for evening courses, exams or extended field trips. Students are expected to be available for classes during these times.

Course Units/Topics

Lectures

1. Introduction to environmental contaminants
    - Why do we care about Environmental Contaminants?
    - Types of environmental contaminants
        - Air pollutants
        - Biological contaminants
            - Algae bloom, toxins
        - Chemical contaminants
            - Inorganic contaminants---metals
            - Organic contaminants ---hydrocarbons, halogenated hydrocarbons, BTEX
        - Physical contaminants
        - Persistent organic pollutants

- PCBs
- PAHs

2. Environmental contaminants properties
   - Physical-chemical properties: physical state, phase partitioning, diffusivity, solubility, vapor pressure
3. Sources of Environmental contaminants
   - Anthropogenic sources
     - Energy related: oil and gas, hydraulic fracturing, mining
     - Non-energy related: pulp and paper industry, chemical industry, agriculture
   - Natural sources
     - Volcanos
     - Forest fire
     - Flooding
4. Contaminant Fate and Transport
   - Mass balance
   - Movement of Pollutants in Surface water, GW, Sediment, air and soil
   - Factors affecting contaminant transport
   - Basic transport processes
     - Advection
     - Dispersion
     - Diffusion
   - Chemical distribution among phases
     - Henry's law
     - Solubility
     - Vapor pressure
     - Absorption and adsorption
   - Contaminant Transformation
     - Chemical processes: acid-base reactions, complexation, phase change
     - Biological processes
   - Contaminant degradation process
     - Abiotic-hydrolysis
     - Biotic-biodegradation

5. Contaminant Risk Assessment
    - Key components of risk assessment
        - Problem Identification
        - Exposure Assessment
            - Ecosystem
            - Routes of exposure
            - Dose response curve
            - Duration and Frequency
            - Exposure and risk calculations
        - Toxicity Assessment
            - Toxicokinetics
            - Toxicodynamics Definitions
            - Threshold Toxicants
            - Non-threshold Toxicants
        - Risk Analysis
6. Contaminant Risk Management
    - What is risk management
    - Risk management process
7. Emerging contaminant
    - What are emerging contaminants-perchlorates, PFCs, nanomaterials, Dioxanes
    - Impact and mitigation practices

Labs/Assignments

This component of the course will consist of the following elements:

1. Guest Lectures
2. Assignments
3. Term Project (includes project report writing and class room presentation)

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