

ESC423
Fundamentals of Remediations
3 Credits

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ESC423 Version: 5



Fundamentals of Remediations

Calendar Description

This course focuses on fundamental aspect of remediation. The course covers the potential contaminant sources, subsurface geochemistry, physical and chemical principles of contaminants and their applications to soil systems. The focus is on the fundamental principles of fate and transport, retardation and transformation processes of contaminants in soil and water media. Students learn about contaminant plume behavior and application of remedial fundamentals to site specific risk assessment.

Rationale

This is required course for Reclamation and Remediation stream of the Bachelor of Applied Science degree program. It focuses on the basic soil physical and chemical principles and processes that govern the movement of pollutants and their remediation. The course is designed to provide a solid foundation in environmental management and a great understanding of the underlying principles that dictate contaminant movement in the environment and the use various remediation technologies for clean-up of contaminants.

Prerequisites

None

Co-Requisites

None

Course Learning Outcomes

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

1. evaluate and support the principles of water and contaminant movement in saturated and unsaturated soils.
2. evaluate the sources of soil contamination and behaviour of inorganic and organic contaminants in soil.
3. determine the physical and chemical transport and retardation processes that impact the movement of contaminants in the subsurface environment.

4. assess the site-specific risks using fundamental concepts.

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:

None

Reference Text:

Boulding, J.R., and J.S. Ginn. 2004. Practical Handbook of Soil, Vadose Zone and Ground Water Contamination. 2nd ed. Lewis Publishers. 691 pages.

Hillel, D. 1998. Environmental Soil Physics. Academic Press, San Diego, CA, 771 pages.

Marshall, T.J., J.W. Holmes, and C.W. Rose. 1996. Soil Physics. 3rd ed. Cambridge University Press, Cambridge, UK. 453 pages.

Bohn, H.L., B.L. McNeal, and G.A. O'Connor. 1985. Soil Chemistry. 2nd ed. John Wiley and Sons, Inc. 341 pages.

McBride, M.B. 1994. Environmental Chemistry of Soils. Oxford University Press, Inc.,
Oxford, UK. 406 pages.

Conduct of Course

The course includes 42 hours of lectures and 14 hours of laboratory sessions (7 sessions). The lectures cover the fundamental principles of environmental soil physics and chemistry and relate them to common challenges such as movement of pollutants into and through the soil. These principles provide students with the theoretical background in understanding the nature of environmental problems and possible options for remediation. The laboratory section complements the theory discussed in the lectures.

Evaluation Procedures

Labs and Assignments	25%
Midterm examination	35%
Final Examination	<u>40%</u>
Total	100%

To obtain credit in this course, all labs and assignments must be completed. Each lab report will be evaluated for organization and use of proper technical language. The lab reports will be due two weeks after the lab has been completed. Please note that LATE REPORTS WILL NOT BE ACCEPTED, A MARK OF ZERO WILL BE ASSIGNED.

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): Lab reports, assignments and examinations/Goals 1-4
A2. by using written, spoken, and/or visual formats and media to communicate and meet needs of each particular audience
Evaluation(s)/Goal(s): Lab reports, and assignments/Goals 1-4
A3. by using libraries, Internet, technical publications, journals and other sources to find pertinent information
Evaluation(s)/Goal(s): Lab reports and assignments /Goals 1-4

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): Lab reports and assignments/Goals 1-4

B2. by using interpersonal skills to resolve conflict, relate to others, and assist others
Evaluation(s)/Goal(s): Lab reports and assignments/Goals 1-4
B3. by contributing and listening to others as group determines realistic objectives, prioritizes tasks, and identifies resources and timelines
Evaluation(s)/Goal(s): Lab reports and assignments/Goals 1-4
B4. by treating other members of the group open-mindedly and fairly
Evaluation(s)/Goal(s): Lab reports and assignments/Goals 1-4
B5. by developing tactics/strategies to accomplish tasks
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4

C. Critical Thinking Skills

C1. by seeing critical thinking as a lifelong process of self-assessment
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C2. by examining problems closely
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C4. by seeking out the truth
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C5. by finding solutions; make decisions
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
C7. by seeing connections between topics and use knowledge from other disciplines to enhance reading and learning experiences
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4

D. Adaptability Skills

D1. by working independently or as part of team
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
D2. by carrying out multiple tasks or projects
Evaluation(s)/Goal(s): Lab reports and assignments /Goals 1-4
D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done
Evaluation(s)/Goal(s): Lab reports and assignments /Goals 1-4
D4. by being open and respond constructively to change and uncertainty
Evaluation(s)/Goal(s): Lab reports and assignments /Goals 1-4

E. Positive Attitude and Behavioural Skills

E1. by dealing with people, problems, and situations with honesty, integrity, and personal ethics
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
E2. by showing interest, initiative, and effort
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4
E3. by affirming the need for positive solutions and encourage positive interaction and feedback
Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4

E4. by balancing personal and family activities with job-related activities

Evaluation(s)/Goal(s): Lab reports, assignments and examinations/Goals 1-4

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 contaminated site remediation
2. Identification of contaminants and sources/pathways
3. Subsurface geochemistry
 - o Environmental parameters: pH, redox potential, salinity
 - o Characteristics of geo-chemical system: thermodynamics, equilibrium, phases and speciation
4. Soil, vadose zone and saturated zone principals
 - o Soil - physical and chemical properties
 - o Soil/water principals
 - o Water in saturated zone
 - o Water in vadose zone
 - o Water storage and flow
5. Contaminant physical and chemical properties affecting fate and transport
 - o Solubility
 - o Vapor pressure
 - o Density
 - o Viscosity
6. Contaminant transport processes
 - o Advection
 - o Dispersion
 - o Diffusion
 - o Facilitated transport
7. Contaminant retardation and transformation processes
 - o Filtration
 - o Sorption
 - o Precipitation
 - o Transformation and degradation
8. Contaminant plume behavior
 - o Factors affecting plume behavior
9. Conceptual site model and remedial endpoints
10. Application of fundamentals to site specific risk assessment

Laboratory/Assignment Component

1. Guest speakers (as available)
2. Assignments
3. In-house laboratory exercises
4. Term project



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