

ESC422

Remediation Technologies

3 Credits

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ESC422 Version: 8



Remediation Technologies

Calendar Description

This course focuses on the use of cost-effective technologies for cleaning up contaminated soils and groundwaters. The course includes a description of the remediation criteria/guidelines for various contaminants developed at both provincial and federal levels. The focus is on remediation technologies for soil such as: soil vapour extraction (SVE), chemical oxidation, thermal incineration, bioremediation, phytoremediation and multiphase extraction and for contaminated ground water: source control, ground water barriers and flow control, pump and treat method and In-situ treatment.

Rationale

This is a required course for the Bachelor of Applied Sciences degree program, Reclamation and Remediation major. The increased commercial and industrial activity in Alberta has resulted in increased soil and groundwater contamination. This course provides the backbone for determining the kinds of information that is required in order to develop a cost-effective remediation plan for contaminated soils and groundwaters. The course combines the theory and practical components of contaminant remediation with a strong focus on the oil and gas industry. The theory deals with the physical and chemical properties of various contaminants found in petroleum products. The practical aspect deals with ways of determining the appropriate remediation technologies, their effectiveness in various scenarios, design and installation as well as the monitoring process.

Prerequisites

[ESC423](#)

Co-Requisites

None

Course Learning Outcomes

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

1. assess the key physical, chemical and toxicological properties of contaminants (organic and inorganic) and how these influence the choice of an effective remediation technology.
2. determine and be able to defend the appropriate remediation technologies for various soil types, hydrologic conditions, and land uses.
3. support and compare the most common remediation technologies (physical, chemical and biological) for organic and inorganic contaminants.
4. create and construct cost-effective remedial plans for various scenarios.

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 groundwater contamination: assessment, prevention and remediation. 2nd ed. 691 pages.

Grasso D. 1993. Hazardous waste site remediation, source control. Lewis Publishers.

Sellers K. 1999. Fundamentals of hazardous waste site remediation. CRC press, 326 pages.

Other materials/websites

Canadian Council of Ministers of the Environment. 2000. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 2001. Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbon in Soil - Tier 1 Method. Canadian Council of Ministers of the Environment, Winnipeg.

Alberta Tier I Soil and Groundwater Remediation guidelines. February 2, 2016.

<http://aep.alberta.ca/lands-forests/land-industrial/inspections-and-compliance/documents/AlbertaTier1Guidelines-Feb02-2016A.pdf>.

Alberta Environment and Parks.

Alberta Tier II Soil and Groundwater Remediation Guidelines. February 2, 2016

<http://aep.alberta.ca/lands-forests/land-industrial/inspections-and-compliance/documents/AlbertaTier2Guidelines-Feb02-2016C.pdf>

Alberta Environment and Parks.

Federal Remediation Technologies Roundtable. Technology Screening Matrix.

<https://frtr.gov/matrix/default.cfm>

Conduct of Course

This course includes 56 hours of lectures and 28 hours of laboratory/field visits. The lectures cover the fundamentals of organic and inorganic contaminants and the appropriate technologies for remediation of contaminated soils and groundwater. The course provides the theoretical background on the physical and chemical properties of contaminants and what role these properties play in choosing an effective remediation method for specific site conditions. Field trips, guest lectures and assignments will provide exposure to various contaminated site scenarios as well as common remediation technologies.

Evaluation Procedures

The final mark consists of:

Midterm	35%
Final	40%
Assignments/Term Project	25%
Total	100%

To obtain credit in this course, all labs and assignments must be completed. Lab/field trip reports are due two weeks after each lab/field trip unless stated otherwise. Please note that late reports WILL NOT BE ACCEPTED, a mark of zero will be assigned for late reports.

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): Field trip reports, assignments, term project, midterm and final exam/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): Field trip reports and term project/Goals 1-4
A3. by using libraries, Internet, technical publications, journals and other sources to find pertinent information
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/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): Field trip reports and term projects/Goals 1-4
B2. by using interpersonal skills to resolve conflict, relate to others, and assist others
Evaluation(s)/Goal(s): Field trip reports and term projects/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): Field trip reports and term projects/Goals 1-4
B4. by treating other members of the group open-mindedly and fairly
Evaluation(s)/Goal(s): Field trip reports and term projects/Goals 1-4
B5. by developing tactics/strategies to accomplish tasks
Evaluation(s)/Goal(s): Field trip reports and term projects/Goals 1-4

C. Critical Thinking Skills

C1. by seeing critical thinking as a lifelong process of self-assessment
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/Goals 1-4

C2. by examining problems closely
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/Goals 1-4
C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/Goals 1-4
C4. by seeking out the truth
Evaluation(s)/Goal(s): Field trip reports, exams, assignments and term project/Goals 1-4
C5. by finding solutions; make decisions
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/Goals 1-4
C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/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): Field trip reports, assignments and term project/Goals 1-4

D. Adaptability Skills

D1. by working independently or as part of team
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/Goals 1-4
D2. by carrying out multiple tasks or projects
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/Goals 1-4
D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/Goals 1-4
D4. by being open and respond constructively to change and uncertainty
Evaluation(s)/Goal(s): Field trip reports, assignments and term projects/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): Field trip reports, assignments and term project/Goals 1-4
E2. by showing interest, initiative, and effort
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/Goals 1-4
E3. by affirming the need for positive solutions and encourage positive interaction and feedback
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/Goals 1-4
E4. by balancing personal and family activities with job-related activities
Evaluation(s)/Goal(s): Field trip reports, assignments and term project/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. Evaluating Contaminant Conditions and Remedial Options
2. Remediation Technologies for Contaminated Soil
 - Soil Vapour Extraction
 - Bioventing
 - Hydraulic and Pneumatic fracturing
 - Bioremediation
 - Chemical oxidation
 - Multiphase extraction
 - Excavation and disposal
 - In-situ soil flushing

- In-situ air sparging
 - Phytoremediation
 - Thermal Incineration
3. Remediation of Contaminated Groundwater
- Source control
 - Ground water barriers and flow control
 - Pump and treat method
 - In-situ treatment
4. Site Closure Post Remediation

Laboratory/Assignment Component (as available, weather dependent):

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

1. Field Trips
2. Guest Speakers
3. Assignments
4. Term Project (includes project report writing and class room presentation)



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