

ESC 419
Soil Chemistry
3 Credits

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ESC 419 Version: 2



Soil Chemistry

Calendar Description

The focus of this course is to examine and practice important concepts of soil chemistry providing foundational and applied scientific knowledge applicable to the environmental professional. Students learn the processes of soil chemistry through multimedia lecture. In a lecture setting students explore and practice topics including: working with the EM38, water holding capacities, calculations, bulk density, speciation and salinity/sodicity testing. Students also gain an expanded knowledge of cation exchange capacity, sorption and ion exchange, clay structures, pH, ionic strengths, hydration, hydrolysis, salinity, organic matter and acidity.

Rationale

This is a required course for the Bachelor of Applied Science: Environmental Management degree. Companies and professional bodies recognize soil chemistry as one of the core knowledge areas required in the workplace. Students who become certified professionals and work in the environmental industry as a career will find this course beneficial. The course is an advanced level course that covers the foundations of soil chemistry to provide the students the basis to further understand the mechanisms of soil which supports other environmental areas of concern including vegetation, wildlife and human infrastructure. The course is aimed to provide an applied knowledge of soil chemistry through a variety of labs that examine topics that the students may encounter in their professional careers.

Prerequisites

None

Co-Requisites

None

Course Learning Outcomes

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

1. complete basic calculations in relation to soil chemistry concepts.

2. analyze field reports with respect to various soil parameters that are commonly used to assess soils in the field.
3. identify and evaluate the importance of clay structures in relation to the management of environmental issues.
4. conduct an EM38 survey and analyze the data collected.
5. synthesize information in regards to speciation, salinity, organic matter, acidity and ionic strengths.
6. characterize mineral and organic soil phases and their relationship to soil chemical properties.
7. explain importance of soil solutions, solids and gases.
8. explain where reactions occur and the impacts of these reactions on the environment.
9. analyze potential mitigation strategies in relation to the chemical processes.

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 Textbook(s):

Strawn, D.G. 2015. Soil Chemistry. 4th ed. Wiley Blackwell, United Kingdom.

Reference Textbook(s):

Essington, M.E. 2015. Soil and Water Chemistry: An integrative approach. 2nd ed. CRC Press, Florida.

Sparks, D.L. 2003. Environmental Soil Chemistry. 2nd ed. Academic Press, Cambridge.

Conduct of Course

This course is lecture based. The midterm and final exams reflect content from the lecture material.

Evaluation Procedures

The final grade is an aggregate of the following components:

In-Class assignments/quizzes/ projects	30%
Exam 1	35%
Exam 2	<u>35%</u>
	100%

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): Written Exam 1 and 2; Goals 1-9; Assignments/activities
A2. by using written, spoken, and/or visual formats and media to communicate and meet needs of each particular audience
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
A3. by using libraries, Internet, technical publications, journals and other sources to find pertinent information
Evaluation(s)/Goal(s): Assignments/Activities

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

C. Critical Thinking Skills

C1. by seeing critical thinking as a lifelong process of self-assessment
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C2. by examining problems closely
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C3. by examining beliefs, assumptions, and opinions, and weigh them against the facts
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C4. by seeking out the truth
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C5. by finding solutions; make decisions
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C6. by incorporating new ideas that may not necessarily agree with previous thought on the topic.
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
C7. by seeing connections between topics and use knowledge from other disciplines to enhance reading and learning experiences.
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities

D. Adaptability Skills

D1. by working independently or as part of team
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
D2. by carrying out multiple tasks or projects
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
D3. by being innovative and resourceful: identify and suggest alternative ways to get the job done
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
D4. by being open and respond constructively to change and uncertainty
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities

E. Positive Attitude and Behavioural Skills

E1. by dealing with people, problems, and situations with honesty, integrity, and personal ethics.
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
E2. by showing interest, initiative, and effort
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
E3. by affirming the need for positive solutions and encourage positive interaction and feedback.
Evaluation(s)/Goal(s): Written Exam 1 and 2; Goals 1-9; Assignments/activities
E4. by balancing personal and family activities with job-related activities
Evaluation(s)/Goal(s): Assignments/Activities

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

Lecture Periods

Unit 1 - Introduction to Soil Chemistry

- a. SI system review
- b. History of soil chemistry

Unit 2 - The Solid Phases of Soil

- a. Primary minerals
- b. Secondary minerals
- c. Weathering
- d. Soil structure
- e. Organic matter
- f. Clay interactions and organic clay complexes

Unit 3 - Soil Solution (Liquid Phase) and Interactions with Soil Surfaces

- a. Extraction of soil solution
- b. Interactions of solutions with solutions
- c. Interactions of solutions with solids

Unit 4 - Soil Redox Reactions

- a. Location of redox reactions
- b. Changes in chemical behaviours

Unit 5 - Soil Acidity

- a. pH
- b. Buffering
- c. Influence on nutrient availability/ metal contamination
- d. Sources

Unit 6 - Soil Salinity

- a. Impacts on soil quality
- b. Mechanisms
- c. Mitigation

Unit 7 - Soil Contamination and Remediation

- a. Impacts on soil quality
- b. Mitigation



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