

**UM Syllabus**  
**Soil Chemistry (SOIL 7130)**

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## **COURSE DETAILS**

Course Title: Soil Chemistry

Course Number: SOIL 7130

Academic Session: Winter 2024

Number of Credit Hours: 3

Class Times & Days of the Week: Mondays, Tuesdays, and Fridays from 1:30 pm to 2:20 pm.

Pre-Requisites: None

Instructor Name: Inoka Amarakoon (Inoka)

Office Hours or Availability: I am available for individual meetings. Email works best to schedule a meeting.

Office Phone Number: (204) 807-1167

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## **COURSE DESCRIPTION**

This graduate-level course provides an in-depth exploration of soil chemistry for sustainable land management, efficient agriculture, and environmental conservation. It offers valuable insights into the chemical composition of the soil and chemical reactions in the soil that are intertwined with nutrient cycling and nutrient storage, water filtration and storage, gas exchange with the atmosphere with links to carbon sequestration and climate change mitigation, the habitat for soil micro and macro organisms, being a medium for plant growth, soil redox state, contaminant fate and transport, and the provision of food, fibre, fuel, medicines for the global population.

## **COURSE GOALS AND LEARNING OBJECTIVES**

The course aims to provide participants with a comprehensive understanding of the chemical properties, processes, and interactions within soils that enable the soils to provide services that sustain life on earth and ways to manage this resource sustainably.

By the end of the course, the participants will understand (i) soil composition, (ii) soil chemical properties and processes, (iii) interactions between soil components and their impact on nutrient dynamics, (iv) environmental implications of soil chemistry, including pollution and remediation, (v) concepts in soil organic matter, microbial interactions and carbon sequestration, (vi) the impact of agricultural and other land management practices on soil chemical properties and ecosystem at large, (vii) sustainable soil management strategies, (viii) soil sampling and analysis for chemical properties, (ix) critical evaluation of published research in soil chemistry, (x) independent research of soil chemistry topics.

## **COURSE MATERIALS AND TECHNOLOGY**

Lecture slides and reference material are posted on UMLearn. Class communications are posted on UMLearn and emailed, and the class is expected to check the UMLearn and University email accounts to stay up-to-date with class communications. There is no required textbook for this course, but recommended readings for the class are posted on UMLearn.

## EXPECTATIONS AND POLICIES

- Regular attendance in lectures is expected from 1:30-2:20 pm on Mondays, Wednesdays, and Fridays to enable a structured and focused learning experience, active participation, a sense of accountability and responsibility, time management skills, and overall academic performance.
- Active engagement in learning and classroom activities is expected.
- The instructor encourages questions during the class, and questions via emails are answered within 24 hours of receiving them from Monday to Friday.
- It is expected to respect the University policy on respectful work and learning environments. <https://umanitoba.ca/governance/governing-documents/governing-documents-university-community#respectful-work-and-learning-environment-rwle>
- Governing Documents: University Community - [Governing Documents: University Community | Governance | University of Manitoba \(umanitoba.ca\)](#)
- Student Accessibility Services - [Accessibility for students | University of Manitoba \(umanitoba.ca\)](#)
- Recording of Classes: The instructor holds copyright over the course materials, presentations, and lectures that form part of this course. No audio or video recording of lectures or presentations is allowed in any format without the instructor's permission. Paper and digital course materials are only for the participant's private study and research.
- Academic Integrity: Plagiarism or any other form of cheating in examinations, term tests, or academic work is subject to academic penalties. Students should acquaint themselves with the University's policy on plagiarism, cheating, exam impersonation, and duplicate submission.

## LECTURE SCHEDULE

Date	Lecture Topic
Jan 8 – 24 (08 Classes)	<b>Module 1: Soil Components</b> Mineral weathering and Soil formation Soil minerals and crystalline structures Soil colloidal fraction, the seat of soil chemistry Critical appraisal of related scientific literature
Jan 26 – Mar 1 (16 Classes)	<b>Module 2: Fundamentals of Soil Chemistry</b> Ion exchange processes and cation-anion interactions Chemical thermodynamics and ionic equilibria Chemical kinetics Mineral solubility Oxidation-reduction reactions Acid-base theory, soil acidity, alkalinity, salinity, and sodicity Sorption processes in soil Critical appraisal of related scientific literature
Mar 4 – 8 (03 Classes)	<b>Module 3: Nutrient Dynamics and Plant Nutrition</b> Chemical transformations of essential nutrients Soil-plant interactions and nutrient availability Micronutrient chemistry and availability

	Role of soil colloids in nutrient retention Nutrient management for sustainable agriculture and environmental conservation Critical appraisal of related scientific literature
Mar 11 – 15 (03 Classes)	<b>Module 4: Soil Carbon, Carbon Sequestration, and Climate Change</b> Soil carbon dynamics Role of soils in climate change mitigation Practices for enhancing soil carbon sequestration Microbial role in carbon cycling Impact of organic matter on soil health Critical appraisal of related scientific literature
Mar 18 – 22 (03 Classes)	<b>Module 5: Environmental Soil Chemistry</b> Soil pollution, remediation, and implications for human and environmental health Environmental fate of excess nutrients and contaminants Beneficial Management Practices (BMPs) to improve water quality Critical appraisal of related scientific literature
Mar 25 – 27 (03 Classes)	<b>Module 6: Field and Laboratory Techniques in Soil Chemistry</b> Soil sampling and laboratory techniques to measure soil chemical parameters, nutrients, inorganic elements, and organic compounds in the environment. Critical appraisal of scientific literature
April 1 – 10 (05 Classes)	<b>Module 7: Research Seminar and Project</b> Critical analysis of soil chemistry literature Presentations and discussions of soil chemistry topics

## COURSE ASSESSMENT

### Description of Assignments

**Term Paper:** Participants will develop a term paper in the format of a review paper, synthesizing existing knowledge, identifying gaps in the literature, and contributing to a deeper understanding of the research topic. The main components to include are a title, abstract, introduction, main body, discussion, conclusions, and references. Participants can select a topic relating to the thesis research and/or personal interest in soil chemistry. Submit your title and outline for the term paper before the winter break on 19-23 Feb 2024, and the instructor will give feedback. A completed term paper is due on April 10, 2024, the last day of the classes. Early submissions are encouraged and will be assessed and returned as they come. Assignment handouts are posted on the course webpage of UMLearn for further details.

**Review of Scientific Literature:** Published literature on soil chemistry, including peer-reviewed scientific papers, will be posted to home reading on UMLearn to increase the understanding of the applications of soil chemistry principles in research and development as the course progresses. Participants will review posted literature following a critical appraisal process and submit a reviewer report including a summary of the paper citing innovativeness and strengths and weaknesses of each section of the publication, evaluating the title whether to accurately reflect the content of the paper, abstract for its clarity, completeness, and its ability to provide an overview of the study, introduction for its clarity in presenting the research question, context, and

significance, clarity of the research objectives and hypotheses, methodology for its appropriateness in addressing the research question, transparency in describing and appropriateness of experimental design, data collection, and statistical methods, results for clarity in presentation and organization of the results, discussion for the appropriate interpretation of results and their implications, conclusions for their alignment with the study's objectives and appropriateness for drawn from the results, completeness and accuracy of the reference list, and overall flow and clarity of the paper. Assignment handouts are posted on the course webpage of UMLearn for further details.

**Grade Evaluation**

Attendance and Participation in Class Discussions..... 5%  
 Review of Scientific Literature Assignments ..... 25%  
 Term paper ..... 25%  
 Class Presentations..... 10%  
 Final Examination ..... 35%

**GRADING**

Letter Grade	Percentage out of 100	Grade Point Range	Final Grade Point
A+	91-100	4.25-4.5	4.5
A	85-90	3.75-4.24	4.0
B+	80-84	3.25-3.74	3.5
B	70-79	2.75-3.24	3.0
C+	65-69	2.25-2.74	2.5
C	60-64	2.0-2.24	2.0
D	50-59	Less than 2.0	1.0
F	<50		0

**IMPORTANT DATES**

First day of course..... January 8, 2024  
 Winter Term Break..... February 19 -23, 2024  
 Voluntary withdrawal date..... March 20, 2023  
 Good Friday (no class)..... March 29, 2024  
 Final day of course..... April 10, 2024  
 Exam period..... April 12 - 26, 2024