University of Manitoba | Price Faculty of Engineering
Department of Biosystems Engineering

Course Outline

Instruction Team

- Vanessa Krahn, P.Eng.
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Student Hours

- Individual assistance is available by appointment.

Teaching Assistant

- Thusyanthy Akileshan
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Location

- **E2-155 (Lectures)**
  Mon 1:30 - 2:20 PM
  Wed 1:30 – 2:20 PM
  Fri 1:30-2:20 PM
- **E3-282 (Lab)**
  Wed 2:30 - 5:15 PM

Contact Hours

- 4 credit hours
- Lectures: 37 hours
  Laboratories: 24 hours

Prerequisites:

- SOIL 4060, CIVL 2790 or BIOE 2790.

Course Website:

http://umanitoba.ca/umlearn

Traditional Territories Acknowledgement

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

BIOE 4620 Remediation Engineering

Fall 2022

Course Objectives

The theoretical basis for the engineering design of different remediation technologies to treat contaminated soil and groundwater will be introduced. Methods for site characterization, monitoring of progress in remediation, and modelling of the remediation process will be presented. Different methods such as soil washing, air sparging, bioremediation, phytoremediation, constructed wetlands, electrokinetic remediation, reactive barriers will be discussed.

Course Content

The course covers an overview of groundwater hydrology and contaminant transport. Then it uses these concepts to design different types of remediation systems for the remediation of contaminated soil and groundwater.

The following topics will be covered:

- Regulatory Environment
- Site Characterization
- Contaminant Characterization
- Principles of Flow and Contaminant Transport
- In-situ Reactive Zones
- Monitored Natural Attenuation
- Bioremediation
- Pump & Treat
- Phytoremediation
- Soil Vapour Extraction / Air Sparging / Bio-Venting
- Reactive Walls and Barrier Technologies

Textbook

Course hand-outs will be posted to UMLearn.

Supplementary Textbooks

- Suthersan, S. S., J. Horst, M. Schnobrich, N. Welty, and J. McDonough. 2017. Remediation Engineering (p. iv). CRC Press. 2017. Remediation Engineering: Design Concepts, Second Edition
- Fetter, C. W., T. Boving, and D. Kreamer. 2018. Contaminant Hydrogeology, Third Edition
- Domenico, P.A. and F.W. Schwartz. 1998. Physical and Chemical Hydrogeology. Second Edition. John Wiley & Sons. (ISBN: 0-471-59762-7)
- Hillel, D. 2003. Introduction to Environmental Soil Physics

Accreditation Details

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 75%
- Engineering Design: 25%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Grading Scale

Letter	Mark
A+	92–100
A	85–91
B+	78–84
B	72-77
C+	66–71
C	60–65
D	50-59
F	< 50

Learning Outcomes

By the end of this course, you will be able to:

No.	Learning Outcome
1	Explain the principles associated with the design of remediation systems.
2	Analyze an existing field scenario to determine the most appropriate remediation strategy.
3	Use models to predict the outcomes from a remediation strategy.
4	Design and evaluate remediation systems for specified scenarios.
5	Summarize and present the results of the design process in an oral presentation and report
6	Apply what was learned in the classroom to novel situations in the workplace

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	4											
2		4		3								
3					3							4
4		5		4								
5				4	4	4	4	4				4
6									3			3

CEAB Graduate Attributes Assessed

PA.3 – Analyzes and solves complex engineering problems
DE.3 – Designs components and a remediation based on real-life scenarios
KB.3 – Recalls and defines, and/or comprehends and applies information, principles and concepts in engineering design
CS.3 – Makes an oral presentation and written report of the remediation design

Important Dates

- **Early Withdrawal Deadline**
  September 20, 2022
- **National Day for Truth and Reconciliation**
  September 30, 2022
  No classes or examinations
- **Thanksgiving**
  October 10, 2022
  No classes or examinations
- **Fall Term Break**
  November 7-10, 2022
  No classes or examinations
- **Remembrance Day**
  November 11, 2022
  No classes or examinations
- **Voluntary Withdrawal Deadline**
  November 22, 2022
- **Safety Test Deadline**
  December 12, 2022
- **Last Day of Classes**
  December 12, 2022

Evaluation

Component	Value (%)	Learning Outcomes Evaluated	Description
Tutorials/Labs	20	1,2,4	There will be a lab/tutorial every Wednesday, which is due five days later on 4:30 pm Monday (unless otherwise specified).
Two Mid-term Tests	25	1,4	Two 50 minute Mid-term tests will be administered on the lecture periods of October 5 and November 4, 2022 (unless otherwise specified). Each mid-term test will be worth 12.5%.
Final Project	20	2,3,4,5	This is a group project presented in report format (worth 15%) and a group presentation which is individually marked (worth 5%)
Final Exam	35	1,4,6	A cumulative final exam worth 35% of your grade will be administered during the final examination period.

Course Policy

Late assignments will be penalized 10% of the assignment grade per day late, while missed assignments will receive a zero. Assignments will not be accepted after marked assignments of others have been returned to the class. Assignments/Submissions may be analyzed using electronic plagiarism tools. Students are allowed to discuss laboratory results with a lab partner or others, but you must write your final reports independently. Copying or joint production of reports will result in both reports receiving a zero mark. Students who cannot write the mid-term exam for medical (or other acceptable) reasons will have their final examination weighted to include the mid-term weighting.

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Requirements/Regulations

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.
- All email communication must conform to the Communicating with Students university policy.

Communicating with Students

- Attending lectures and laboratories is essential for the successful completion of this course.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don't need to share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

Self-Declaration Form for Brief or Temporary Absence

- This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

Self-Declaration Policy for Brief or Temporary Absences

- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance, and withdrawal.

General Academic Regulations

Engineering Academic Regulations

- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Resources

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

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