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

Course Outline

Instruction Team

- Dr. (Ranjan) Sri Ranjan, P.Eng.
  E1–346B EITC Bldg
  (204) 474–9344
  sri.ranjan@umanitoba.ca

Student Hours

- Individual assistance is available by appointment.

Teaching Assistants

- Thushyanthy Akileshan
  akilesht@myumanitoba.ca

Location

- **E2-351 EITC Bldg**
  MWF 1:30 - 2:20 pm
- **E2-351 EITC Bldg**
  W 2:30- 4:15 pm

Contact Hours

- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Tutorial Lab:
  2 hours x 13 weeks = 26 hours

Prerequisites:

CIVL 2790 (or 023.279) or MECH 2262 (or MECH 2260 or 025.226)

Course Website:

http://umanitoba.ca/umlearn

Traditional Territories Acknowledgement

The University of Manitoba campuses are located on the original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate and Dene, and on the National Homeland of the Red River Métis.

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 2024

Course Description

The theoretical basis for the engineering design of different remediation technologies to treat contaminated soil and groundwater will be presented. Methods for site characterization, monitoring of progress in remediation, and modeling 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 Goals

- To prepare students who plan to work in remediation engineering
- Present concepts of ground water hydrology and contaminant transport needed to implement in remediation engineering
- To provide students with an opportunity to use the engineering design process to solve problems.
- To provide students with an opportunity to collaborate equitably with group members in a team setting to manage an engineering design project.

Course Content

- Concepts in groundwater hydrology
- Concepts in contaminant transport
- Different types of remediation techniques
  - Pump-and-treat
  - Air sparging/bioventing
  - Electrokinetic remediation
  - Bioremediation
  - Phytoremediation
  - Constructed wetlands
  - Vegetative filter strips
  - Reactive walls and barrier technologies
- Work on group design project to remediate a contaminated site and make a presentation.

Course Delivery

Lectures and Tutorial lab time will proceed as listed in the left and this time will be used to deliver course content, provide time for design work, testing and presentations.

Recommended Reading

Lecture handouts and supplemental materials will be distributed through the course website (www.umlearn.com).

Supplementary Reading

Suthersan, S.S., J. Horst, M. Schnobrich, N. Welty, and J. MccDonough. 2016. Remediation Engineering Design Concepts. CRC Press (ISBN: 978-1138582743)

Fetter, C. W., 1999. Contaminant Hydrogeology, Second Edition. Prentice Hall (ISBN: 0-13-751215-5) (This book includes a limited version of Visual MODFLOW)

Fetter, C.W. and D. Kreamer. 2022. Applied Hydrogeology. Waveland Press,

Domenico, P.A. and F.W. Schwartz. 1997. Physical and Chemical Hydrogeology. Second Edition. John Wiley & Sons. (ISBN: 978-0471597629)

Hillel, D. 2013. Introduction to Soil Physics. Academic Press (ISBN: 978-0123485205)

Radcliffe, D.E. and J. Simunek. Soil Physics with Hydrus: Modelling and Applications. CRC Press. (ISBN: 978-1420073805)

Accreditation Details

Accreditation Units

- 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

I - Introduced
D – Intermediate (Developing)
A - Advanced

Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

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 formal report.
6	Apply what was learned in the classroom to novel situations in the workplace.

CEAB Graduate Attributes Assessed

This course will assess the following CEAB graduate attribute indicators shown below:

Indicator (Level)	Indicator Description	Assessment Point
KB.3 (A) (6%) PA.3 (A) (6%) DE.3 (A) (3%)	Recalls and defines, and/or comprehends and applies information, principles, and concepts in engineering design. Analyzes and solves complex engineering problems. Design components based on real-life scenario.	Midterm test
DE.3 (A) (5%) CS.3 (A) (5%)	Designs a remediation plan based on real-life scenario Submit a written report	Written design report
CS.3 (A) (5%)	Make and oral presentation of the remediation plan	Final project presentation
PA.3 (A) (13%) DE.3 (A) (7%)	Analyzes and solves complex engineering problems Designs a component based on real-life scenario	Tutorial/Lab
KB.3 (A) (20%) PA.3 (A) (20%) DE.3 (A) (10%)	Recalls and defines, and/or comprehends and applies information, principles, and concepts in remediation engineering design. Analyzes and solves complex engineering problems. Design components based on real-life scenario	Final exam

Important Dates

- **National Day for Truth and Reconciliation**
  Mon. Sept. 30, 2024
  No classes or examinations
- **Thanksgiving**
  Mon. Oct. 14, 2024
  No classes or examinations
- **Midterm test**
  1:30 pm Wednesday, Nov 6, 2024
- **Remembrance Day**
  Mon. Nov. 11, 2024
  No classes or examinations
- **Fall Term Break**
  Nov. 12-15, 2024
  No classes or examinations
- **Voluntary Withdrawal Deadline**
  November 19, 2024
- **Team Presentations**
  Wednesday, December 4, 2024
- **Final Design Reports due**
  Friday, December 6, 2024
- **Last Day of Classes**
  Mon. Dec. 9, 2024

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Midterm Exams	15	RSR	F, S	2, 3, 4	I
Tutorial Lab	20	TA	F, S	5	I
Design Report	10	RSR, TA	S	4	T
Design Presentation	5	RSR, TA	S	4, 5, 6	T
Final Examination	50	RSR	S	1, 6	I

* Method of Feedback: **F** - Formative (written comments / oral discussion), **S** - summative (numerical grade)

** I/T: **I** – Individual effort, **T** – A team effort

Description of Evaluation Components

Midterm Test: Students will be evaluated on the concepts, problem analysis and design through problem solving.

Final Design Report: Each design team is expected to submit a final design report that fully describes the conceptual solution that has been proposed in response to the design problem posed by the course instructor.

Design Presentation: Design teams will be expected to describe their proposed conceptual solution via a formal PowerPoint presentation.

Tutorial/Labs: There are several tutorials/labs that individual students will complete throughout the term that will contribute to the development of your professional skills.

Late Submission Policy: Deadlines are a reality in the world of engineering. We expect assignments to be completed on time. Assignments submitted after the due date will be docked 10% per day. If students know in advance that they need more time, they are encouraged to speak with instructors, and we will work to accommodate you.

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

- Please copy the Instruction Team in all emails (Instructors and Teaching Assistants). All email communication must conform to the Communicating with Students university policy.

Communicating with Students

- As the Instruction Team, we will do our best to respond to all emails **within 48 hours during working hours** (8:30 AM – 5:30 PM Monday thru Friday). Ex. A Friday night email may not be responded to until the following Tuesday.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. 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 Form for Brief or Temporary Absence

Self-Declaration Policy for Brief or Temporary Absences

- It is the responsibility of each student to contact the instructor in a timely manner if they are uncertain about their standing in the course and about their potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*.

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*

Deferred Final Examinations

Students who miss the regularly scheduled writing of a final examination for valid medical or compassionate reasons will only be allowed to write a deferred exam if the Associate Dean (Undergraduate) approves the request. All requests for a deferred examination *must* be made within 48 hours of the missed exam and follow the procedure described on the Faculty website without exception. Course Instructors *do not have the discretion* to grant deferred final examinations.

Deferred Exam Policy (student experience website)

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 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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