ENVE 5201/4002 Environmental Geotechnical Engineering

Winter 2023

Instructor Elena Zabolotnii, PhD PEng
email: elenazabolotnii@cunet.carleton.ca
phone: 613-520-2600 x1402
office: EDC 4532
office hours: Mon 10:35 – 11:25

Teaching Assistant TBD
email: TBD
office: TBD
office hours: TBD

Course Dates:

Lectures:	January 8 – April 10	Monday	11:35 – 14:25	MacKenzie	**Room 3165**
Tutorials:	January 8 – April 10	Tuesday	11:35 – 12:25	Canal Building	**Room 2400**

April 10th, 2024 classes follow a Friday schedule

Final examination (TBA) to be announced on Carleton University site

A missed final examination will result in a grade of zero unless a medical excuse is provided to the Student Services. In such case, a deferred final examination may be arranged.

Course Description:

This course focuses on landfill design as its main subject. Specific topics include:

- Hydrogeologic principles including groundwater flow, water budget and contaminant transport.
- Landfill design, including:
  - General principles.
  - Landfill liners, including clay leachate interaction, clay liners, geosynthetics and composite systems.
  - Landfill covers, including design principles based on unsaturated soil mechanics and environment-specific factors.
  - Leachate and gas collection systems.
- Landfill operation, monitoring and quality control/quality assurance, including leak detection and control.
- Case studies of geotechnical and geoenvironmental failures of landfills.

Grading

Assignments & Tutorials:	25%
Group Presentation and Report:	25%
Final Examination:	50%

Students who claim illness, injury, or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for alternate arrangements with the instructor and in all cases, this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 4.4 of the University Calendar.

Students missing deadlines or exams due to an illness must submit a Self-declaration for Academic Considerations Form to the instructor within three (3) days. Accommodations cannot be granted more than 72 hours after the deadlines. For final exams, students must submit the self-declaration form in addition to a deferral application (carleton.ca/registrar/deferral) and submit both forms to the Registrar's Office no later than 3 days after the scheduled examination or take-home due date. If an absence from an evaluation is deemed justified:

1) Assignments: the weight of a justified missed assignment will be transferred onto the remaining assignments.
2) Final exam: the student will have to consult the academic secretariat of the faculty for the procedure to follow.

Required Text

1. Clayey Barrier Systems for Waste Disposal Facilities by Rowe, R. Kerry, Quigley, Robert M., Brachman, Richard W. I., and Booker, John R., 2nd ed., 2004. Spon Press, Taylor & Francis Group, London and New York City, 587 pp., ISBN 0-419-22630-3. Available at the bookstore.
2. Lecture notes (Softcopy on Brightspace. You must bring a hardcopy to lectures)
3. Reading materials posted on Brightspace.

Optional Textbooks:

1. Solid waste landfill engineering and design by E.A. McBean, F.A. Rovers, G.J. Farquhar. Prentice Hall 1995.
2. Design, construction and monitoring of landfills by A. Bagchi. Wiley and Sons, Second Edition, 1994.

Additional References

1. Solid Waste Landfill Engineering and Design, Edward A. McBean, Frank A. Rovers and Grahame J. Farquhar, Prentice-Hall, 1995.
2. Design, Construction, and Monitoring of Landfills, Second Edition, A. Bagchi, John Wiley & Sons, 1994.
3. Waste Containment Systems, Waste Stabilization, and Landfills - Design and Evaluation, Hari D. Sharma and Sangeeta P. Lewis, John Wiley & Sons, 1994

Assignment Submission

All assignments and other submissions should be submitted as a hard copy. While you may submit your assignments after the due date, a grade penalty will be applied as follows: -20% if submitted prior to the solutions being posted; and a grade of zero if submitted after the solutions are posted.

Solutions

Assignment solutions will be posted on Brightspace seven days after the assignment due dates.

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

TIME TABLE

Lecture Date:	Lecture Topic:	Tutorial:	Assignments due on the day of the class at 4pm:
January 8	COURSE REVIEW AND OBJECTIVES INTRODUCTION LEGISLATION		
January 15	GEOTECHNICAL PROPERTIES OF WASTE	Tutorial #1: geotechnical properties of waste	
January 22	HYDROGEOLOGIC PRINCIPLES 1/3 • 1D flow through porous media • Review of 2D flow	Tutorial #2: 1D flow through porous media	Assignment 1: geotechnical properties of waste
January 29	HYDROGEOLOGIC PRINCIPLES 2/3 • Water budget • Leachate generation	Tutorial 3: 2D seepage modelling (PLAXIS LE)	Assignment #2: 1D flow through porous media
February 5	HYDROGEOLOGIC PRINCIPLES 3/3 • Contaminant transport 1 • Contaminant transport 2	Tutorial #4: contaminant transport	Assignment #3: 2D seepage modelling (PLAXIS LE)
February 12	LANDFILL DESIGN • Site selection		
February 19	WINTER BREAK		
February 26	LANDFILL LINERS • Compacted clay liners • Geosynthetic Liners • Geomembrane Liners		Assignment #4: contaminant transport
March 4	LANDFILL COVERS • Unsaturated flow • Cover design	Tutorial #5: unsaturated flow	
March 11	LANDFILL OPERATION, MAINTENANCE AND MONITORING • Leachate detection and monitoring • Settlement and stability		Assignment #5: unsaturated flow
March 18	LANDFILL MECHANICAL STABILITY • Settlement • Stability	Tutorial #6: 2D limit equilibrium stability of landfills (PLAXIS LE)	
March 25	REVIEW		Assignment #6: landfill settlement and stability
April 1	Group Presentations		
April 8	Group Presentations		Group Report