Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9696 – Special Topics in CEE: Environmental Design for Waste Disposal

COURSE OUTLINE – Fall 2024

DESCRIPTION

This course is an advanced course in environmental design for waste disposal and includes a complete preliminary design of a landfill facility. The objectives of the course are for the students:

- To develop an understanding of modern waste management practice and the role of landfilling in this context.
- To recognize the wide range of technical and non-technical considerations associated with site selection, approval, design, construction and operation of a modern waste management facility and understand the impact of the engineering solution in a global and societal context.
- To develop an understanding of the sources and characteristics of municipal solid waste and the chemical and biological characteristics of landfill leachate.
- To understand the professional and ethical responsibility of an engineer with respect to waste management including consideration of social, economic, environmental, worker health and safety, and legislative and other regulatory issues.
- To use state-of-the-art computer techniques for assessing the impact of proposed waste disposal sites on groundwater quality.
- To apply mathematical, scientific, and engineering knowledge to the design of the preliminary design for a landfill facility to meet specified needs and legislative requirements.
- To improve communication skills by discussing current waste disposal issues and expressing and defending opinions before their peers.
- To obtain experience working as a member of a design team and hence prepare for the engineering workplace.
- To appreciate the rapidly changing nature of knowledge and technology in this field and the need for life-long learning

ENROLLMENT RESTRICTIONS

Enrollment in this course is restricted to graduate students with bachelor's degree in Civil Engineering, as well as any student that has obtained permission to enroll in this course from the course instructor, as well as the Graduate Chair (or equivalent) from the student's home program.

INSTRUCTOR CONTACT INFORMATION

- Course instructor: Dr. Christopher Power
- Email address: cpower24@uwo.ca
- Lecture hours: 3 hours per week
- Tutorial hours: 1 hour per week
- Administrative Support: SEB-3118, or email: ceeresearchgrad@uwo.ca (research graduate students) or ceeprofessionalgrad@uwo.ca (MEng students)

COURSE FORMAT

The course will be delivered in-person.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
1	**Introduction to Waste Management**		
	Types of Waste	• Lectures • Additional reading material	Week 1
	Solid Waste Generation	• Lectures • Additional reading material	Week 1
	Solid Waste Management	• Lectures • Additional reading material	Week 1
2	**Waste Disposal at Landfills**		
	Municipal Solid Waste and Landfills	• Lectures • Additional reading material	Week 2
	Landfill Regulations and Design Considerations	• Lectures • Additional reading material	Week 2
3	**Solid Waste**		
	Waste Composition	• Lectures • Additional reading material • Assignment	Week 3
	Physical and Chemical Properties	• Lectures • Additional reading material • Assignment	Week 3
4	**Landfill Leachate**		
	Degradation of Waste & Leachate Generation	• Lectures • Additional reading material • Assignment	Week 4
	Leachate Composition	• Lectures • Additional reading material • Assignment	Week 4

	Changes in Leachate Concentration	• Lectures • Additional reading material • Assignment	Week 5
	Estimation of Leachate Generation	• Lectures • Additional reading material • Assignment	Week 5
5	**Landfill Design**		
	Landfill Components	• Lectures • Additional reading material	Week 6
	Landfill Lining System	• Lectures • Additional reading material	Week 6-7
	Leachate Collection	• Lectures • Additional reading material	Week 8
	Final Cover System	• Lectures • Additional reading material • Assignment	Week 9
	Landfill Gas Collection	• Lectures • Additional reading material • Assignment	Week 10
6	**Landfill Operation and Closure**		
	Landfill Operation Plan	• Lectures • Additional reading material	Week 11
	Post-Closure Monitoring	• Lectures • Additional reading material	Week 11

*Note there will be no lectures during reading week (October 12-16, 2024)

SPECIFIC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	35%	• Assignments • Project • Examinations	• Understanding of advanced concepts and theories • Awareness of important current problems in the field of study • Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	10%	• Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment

Application of knowledge	35%	• Assignments • Project • Examinations	• Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing design tools
Professional capacity / autonomy	5%	• Project	• Awareness of academic integrity • Ability to implement established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process
Communication skills	10%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	5%	• Project	• Awareness of the need of assumptions in complex scientific analyses and their consequences • Understanding of the difference between theoretical and empirical approaches • Ability to acknowledge analytical limitation due to complexity of practical problems

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Participation in Class Activities	In-person and posted questions on OWL Brightspace (Forums)	Ongoing	5%
Homework Assignments (four)	Topics 2, 3 Topic 4 Topic 5 Topic 5	Sept 27, 2024 Oct 11, 2024 Nov 15, 2024 Dec 6, 2024	15%
Quizzes (two)	Topics 1-5	Oct 9, 2024 Nov 13, 2024	15%
Design Project	All topics	Nov 29, 2024	25%
Final Exam	All topics	TBD (Dec 9-22, 2024)	40%

*The presented dates are an approximate guide for students and may be subject to change

Note:
(a) **Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.
(b) **Students must turn in their assignments and achieve a passing grade in this component, to pass this course.** Students who do not satisfy this requirement will be assigned 48% or the aggregate mark, whichever is less.
(c) **Students who have failed this course previously must repeat all components of the course.** No special permissions will be granted enabling a student to retain assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.

1. Participation
As part of the course mark breakdown, 10% will be allocated to student participation in class. Participation is an important component of this course and will be assessed by attendance and interaction in the lectures and/or the forums on OWL Brightspace.

2. Assignments
Four assignments will be scheduled during the term. Assignments are to be done individually. Each assignment will be posted on the OWL Brightspace course website on specified weeks. You should review the assignment before the tutorial and may only ask for assistance on a question you have attempted.

Late Assignments: Late assignments will be accepted for 3 days following their due date. 10% per day will be deducted for late assignments. An assignment will not be accepted after 3 days. Extensions are to be negotiated with the course instructor. If no assignment is received for a student, the mark assigned is zero for that assignment. The maximum number of missed assignments for each student will be one; if more than one assignment is missed then a student may be barred from writing the final exam.

Plagiarism on Assignments: Each person must hand in an assignment that contains only their own work. If an assignment is deemed to be similar to another assignment, this will be taken as a case of plagiarism. In such circumstances, both individuals (e.g., the person providing the answer and the person copying it) will both receive a mark of zero on the entire assignment. For a first offense, both individuals will receive a personal warning and the infraction will be recorded. For a second offense, further action will be taken.

3. Midterm and Final Examinations
Two quizzes (1 hour each) will be held during the lecture period on Wednesday, October 9, 2024 and Wednesday, November 13, 2024. The final examination (3 hours) will be held during the examination period between December 9, 2024, and December 22, 2024. The quizzes and final examination will be **CLOSED BOOK,** and a sheet will be provided containing necessary equations. No programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted. A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it!

4. Project
Students will conduct a project that involves the design of a hypothetical landfill. The design project is a major component of the course. You will be asked to form "design teams" comprising 4 to 5 students (the actual number will be specified when the number of students in the course is known). You will be assigned a site that has previously been considered for landfilling during or following an extensive environmental assessment. You will have access to key hydrogeologic data arising from these studies. The site boundaries of the area investigated will be shown on the drawing, however, you may select your own footprint subject to the requirement that the landfill must be located within the boundaries shown. You are to design the landfill subject to a number of constraints that will be specified (in addition to those arising from the Environmental Assessment Act, the Environmental

Protection Act, 1998 Landfill Standard Guidelines (Ontario Regulation 232/98) MOE and MOE Guidelines for EPA Submissions and Government waste diversion targets).

Although basic information concerning the site is provided for your assistance, this information is not complete, and it will be necessary for you to obtain additional information. The submission should be sufficiently detailed such that it could be presented to the MOE for review and approval of the undertaking. Your submission should clearly indicate the name of the individual who undertook prime responsibility for each aspect of the work and the name of the individual who reviewed that aspect of the work. All hand calculations are to be on squared paper and must be organized and presented in a neat, clear and professional manner. All pages of calculations must have the date, initials of the originator and initials of the checking engineer. All calculations are to be checked. All drawings are to be of professional quality with the name of originator and checking individual shown. Your group will be required to make an oral presentation of your design and will be expected to defend your design (which will be reviewed by the instructor, teaching assistant, and a peer review group).

Of the marks assigned for the oral presentation and defense of your project, 10% will be assigned for your critical review of the other groups' submissions and 80% will be assigned for the final design submission. Each student will be required to submit a written and signed assessment (with reasons) of how, in their opinion, the marks for the design project should be divided between team members (the instructor will make the final allocation after considering the opinion of all group members and reviewing the work done by each student).

Activities in which collaboration is permitted:

- Participation on the OWL Brightspace course site. Weekly forums will be posted on the course site OWL Brightspace. Each week students are expected to interact with the course content and with each other by posting questions/responding to existing questions on OWL "Forums". Minimum expectation regarding this participation activity is at least one posting per week. Group discussion using "Forums" regarding course material and topics covered in lectures is permitted.
- Assignments: students are encouraged to ask their questions or provide hints to solve given problems using the forums on OWL Brightspace, or in tutorials. Students are not allowed to copy assignments, which will be considered plagiarism.
- Design Project: Students will be divided into groups (4-5 members per group). Collaboration between **only** group members is permitted.

Activities in which students must work alone (collaboration is not permitted):

- Quizzes
- Final Examination

COURSE MATERIAL
Prepared class notes will be made available through the course website on OWL Brightspace, along with other useful reference material and data for assignments. Lecture notes and any posted demonstration videos are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous lectures of the course without the permission from the course instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

REQUIRED TEXTBOOK
No textbook is required.

OPTIONAL COURSE READINGS
The following list contains suggested supplementary references:

- Geotechnical Aspects of Landfill Design and Construction by Xuede Qian, Robert M. Koerner, Donald H. Gray, ISBN 0-13-012506-7. Published 2002 by Prentice-Hall, Inc. Upper Saddle River, New Jersey 07458
- Ontario Regulation 232/98 (key sections in course notes). Available in the Taylor Library and also on the Web at: http://www.canlii.org/on/laws/regu/1998r.232/20040802/whole.html.
- Landfill Standards: a guideline on the regulatory and approval requirements of new or existing landfill sites, Ontario Ministry of the Environment and Energy (MOE), May 1998, Report PIBS365IE. Web link: http://www.ene.gov.on.ca/envision/land/landfill/
- Geotechnology of Waste Management by Oweis, I.S. and Khera, 2nd Edition, PWS Publishing Co., Boston, 1998.
- Solid Waste Landfill Engineering and Design by E.A. McBean, F. Rovers & G.J. Farquhar 1995.
- Barrier Systems for Waste Disposal Facilities by R.K. Rowe, R.M. Quigley & J.R. Booker 2004, Chapman & Hall.

COMPUTING
Use of laptop computers, tablets or smart mobile phones is expected to be for the purpose of participating in the lecture explicitly. They can be used to fill in the gapped notes, participate in class polls, and to register your attendance. Students using the devices for activities not related to this class may be asked to leave.

UNITS
SI units will be used in lectures and examinations.

iCLICKER CLOUD
Classroom Polling: We will be using iClicker Cloud, a cloud-based student response software, in class this semester. This will help me understand what you know, give everyone a chance to participate in class, and provide more interaction on concepts and example questions. We will also use this software to keep track of attendance. At the start of every class, you will register your attendance; only after you do this will you be able to answer any poll questions posted. You are required to bring a device connected to the university Wi-Fi to participate in iClicker Cloud during

class, including a smartphone, tablet, laptop or iClicker remote. You will need to create an iClicker Reef Student account to participate in class.

Creating Your iClicker Reef Student Account: Go to iclicker.com/students or download the iClicker Reef Student app for your Apple or Android device to sign up for a Reef account. You should use your university email address and your University ID (e.g., "cpower24" for student cpower24@uwo.ca) in the Student ID field. You can edit your email address, password, or student ID from your account profile. Do not create and use more than one Reef account as you will only receive credit from a single account.

You do not need to purchase anything – iClicker Cloud is fully supported by Western and is free to all its students. Make sure you choose Western University Ontario when signing up.

Add This Course to Your Reef Account
Institution: Western University Ontario
Course: CEE EnviroDesign_for_WasteDisposal

USE OF ENGLISH
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work, with the exception of the final examination, may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)
The use of AI in the preparation of the project and assignments must be acknowledged in the submission. Please refer to the published Provisional Guidance for the Use of Generative AI in Graduate Studies at Western University.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES
Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence at the following website: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_grad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

CONDUCT

Students are expected to follow proper etiquette to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in course activities and/or is not following the rules and responsibilities associated with the course activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS SERVICES

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Faculty of Engineering has a Student Wellness Counsellor. Information on how to schedule an appointment with the counsellor is available at: https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/Student-Wellness-Counselling.html
Students who are in emotional/mental distress should refer to Mental Health@Western: http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

Students who are not able to meet certain academic responsibilities due to medical, compassionate or other legitimate reason(s), could request for academic consideration. The Graduate Academic Accommodation Policy and Procedure details are available at:
https://www.eng.uwo.ca/graduate/current-students/academic-support-and-accommodations/index.html

ACCESSIBLE EDUCATION WESTERN (AEW)

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program. Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are strongly encouraged to register with Accessible Education Western (AEW): http://academicsupport.uwo.ca/accessible_education/index.html

AEW is a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both AEW and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction.