Colorado State University
Department of Civil & Environmental Engineering

Containment Systems for Waste Disposal

CIVE 558—Fall 2015

General Information

Meeting time:	MWF: 1:00-1:50 PM
Meeting place:	107B Wagar
Prerequisite:	CIVE 355—Introduction to Geotechnical Engineering or equivalent
Textbook:	None
Instructor:	Joseph Scalia, PhD
Email:	joseph.scalia@colostate.edu
Office location:	A217 Engineering Building
Office hours:	TR: 1:00-2:00 PM

Course Description

The course focuses on three technical issues: (1) design of containment barriers used in municipal, hazardous, industrial, energy-production, and mine waste containment applications based on regulations (prescriptive) or performance; (2) use of geosynthetics (polymer materials, including geomembranes, geosynthetic clay liners, etc.) in waste containment systems; and (3) use of conventional and alternative final covers in containment applications. The course involves consideration of the basic physical, chemical, and mechanical properties of materials used in containment barriers, liquid flow (Darcy's law, water balance, unsaturated flow) and contaminant transport (advection and diffusion) through barrier materials, the fate of contaminants (e.g., adsorption, ion exchange, decay, etc.) during migration through barrier materials, and some geotechnical aspects in the design of these systems (e.g., stability of components on slopes).

Course Objectives

1) Synthesize basic principles from several disciplines currently involved in the multi-disciplinary field of geoenvironmental engineering.
2) Provide students with the basic framework for engineering solutions to geoenvironmental engineering problems involving waste containment systems.
3) Motivate students to pursue additional education and/or professional careers in geoenvironmental engineering.

Grading

Homework. Periodic homework assignments will be given throughout the semester and will have a defined due date identified on the assignment. Homework will be due at the start of class on the due date indicated. Late homework will not be graded. I grade homework mostly on effort; a well-presented, neat, clearly reasoned attempt will be given full credit. You will typically have one week to do each assignment. This is a graduate-level course and students are expected to complete their work in a neat and orderly manner and provide logical documentation of the necessary equations, definitions, assumptions, example calculations, references, and any additional supporting material used in solving the problems.

Quizzes. Periodic quizzes will be given throughout the semester. Quizzes will be administered at the beginning or end of lecture and may or may not be announced prior to the instructor administering a given quiz. Quiz questions may include multiple choice, true / false, matching, short answer, and/or computation questions, and will focus on material covered in assigned readings.

Exams. The course will include three exams during the semester: Exams I and II will be administered during class time; Exam III will take place during the scheduled final exam time for this course (see schedule). Exams will be catered to the time duration allotted to the students. Exams will be closed notes and closed book unless otherwise noted. Content on the exams will include quantitative (e.g., calculation problems) and qualitative (short answer) assessments. The distribution of the quantitative and qualitative portions may vary, but will be announced prior to the exam date.

Grading. This course is worth 3-credits, and course grades will be based on the following:

First exam	20%
Second exam	20%
Third (final) exam	20%
Homework	20%
Quizzes	20%
Total	100%

Grades in this course will be based on the following straight-grading scale:

96.7% ≤	A+	≤ 100%	80.0% ≤	B-	< 83.3%
93.3% ≤	A	< 96.7%	76.7% ≤	C+	< 80.0%
90.0% ≤	A-	< 93.3%	70.0% ≤	C	< 76.7%
86.7% ≤	B+	< 90.0%	60.0% ≤	D	< 70.0%
83.3% ≤	B	< 86.7%		F	< 60.0%

Exam grades and final course grades will be based on the above straight-grading scale when the class average is above 75%. If the average is below 75%, the grading scheme will reflect the actual class average. Borderline decisions will be made by examining the student's motivation and quality of work (i.e., participation and professionalism).

Other Important Items

Travel. On occasion, my academic duties require that I must travel (e.g., attend conferences and meetings, present seminars, etc.). I will try to let you know as far in advance as possible. In all cases, we will make up any postponed classes, such that the full semester of lectures will be provided. Thus, I need everyone's course schedules for the semester to determine mutually agreeable dates and times to hold make-up classes.

Make-up Exams. Make-up exams will not be given, except in extraordinary situations and only if I have been notified well in advance of the original exam date.

Course Webpage. All handouts and homework assignments will be placed on the course website. I do not plan on posting solutions to homework or exams; however, you are welcome to compare your answers with mine should a conflict arise.

Change in Assignment. A change in the date of a homework or exam during the semester may be necessary. When such changes are needed, they will be announced in class. If you are absent, you are responsible for finding out what changes, if any, have been made.

Cell Phone Policy. Cell phones will not be allowed during exams. Please turn off or silence phones during class.

Academic Integrity Policy. This course will adhere to the Colorado State University Catalog Academic Integrity Policy and Student Conduct Code. Guidelines for academic integrity as it applies to this course will be presented in class by the end of the second week of class. Students are encouraged to positively impact the academic integrity culture of CSU.

Outline and Tentative Schedule

Month	Date	Day	Topic[1]
Aug.	24	M	Class introduction & overview
	26	W	Brief history of waste containment systems
	28	F	Liner materials & selection
	31	M	Liner materials & selection
Sept.	2	W	Hydraulic conductivity
	4	F	Hydraulic conductivity
	7	M	*No class—Labor Day*
	9	W	Hydraulic conductivity
	11	F	Hydraulic conductivity
	14	M	Hydraulic conductivity
	16	W	Test pads & field measurement of hydraulic
	18	F	Test pads & field measurement of hydraulic
	21	M	Clay mineralogy
	23	W	Clay mineralogy
	25	F	Chemical compatibility
	28	M	Chemical compatibility
	30	W	Polymer science
Oct.	2	F	**Exam No. 1**
	5	M	Compacted clay liners (CCLs)
	7	W	Compacted clay liners (CCLs)
	9	F	Compacted clay liners (CCLs)
	12	M	Compacted clay liners (CCLs)
	14	W	Geosynthetic clay liners (GCLs)
	16	F	Geosynthetic clay liners (GCLs)
	19	M	Geosynthetic clay liners (GCLs)
	21	W	Geosynthetic clay liners (GCLs)
	23	F	Sand-bentonite liners
	26	M	Sand-bentonite liners
	28	W	Geomembrane liners
	30	F	Geomembrane liners
Nov.	2	M	Composite liners
	4	W	Composite liners
	6	F	**Exam No. 2**
	9	M	Contaminant transport
	11	W	Contaminant transport
	13	F	Contaminant transport
	16	M	Drainage & leachate collection
	18	W	Drainage & leachate collection
	20	F	Leak detection
	23-27	MWF	*No class—Fall Recess*
	30	M	Conventional (resistive) covers
Dec.	2	W	Conventional (resistive) covers
	4	F	Alternative (water balance) covers
	7	M	Alternative (water balance) covers
	9	W	Alternative (water balance) covers
	11	F	Alternative (water balance) covers
	16	W	**FINAL EXAM (4:10-6:10p)**

[1] Lecture topics and order are subject to change.