

Department of Civil and Environmental Engineering  
Colorado State University

**CIVE 556 – Seepage and Earth Dams**

**Course Number and Title:** CIVE 556 – Seepage and Earth Dams

**Credits:** 3

**Term to be offered:** Spring 2011

**Time/Location:** M, W and F (11:00 – 11:50 AM) in Engineering E103

**Course Pre/Co-Requisite:** CIVE 355 (Introduction to Geotechnical Engineering)

**Course Description:** Hydraulic conductivity measurements. Seepage analysis and control. Earth dam and embankment design. Computer applications.

**Course Objectives:** At the conclusion of this course, students will be:

- Able to model and analyze seepage in dams and embankments;
- Knowledgeable about the basic types of dams;
- Able to understand how geology and geomaterial type and state (density and stress) influence the design and behavior of dams;
- Able to use computer software for seepage analyses and design of dams and embankments.

**Course Instructor:**

Dr. Antonio Carraro  
Office: Room A219, Engineering Building  
E-mail: carraro@colostate.edu  
Phone: 491-4660

**References:** A single textbook will not be adopted in the course. Recommended references include:

- “Seepage in Soils – Principles and Applications” by L. N. Reddi, 2003, Wiley, ISBN: 978-0-471-35616-5.
- “Seepage, Drainage, and Flow Nets” by Harry R. Cedergren, 1997, 3<sup>rd</sup> edition, Wiley, ISBN: 978-0-471-18053-1.
- “Geotechnical Engineering of Dams” by Robin Fell, Patrick MacGregor, David Stapledon and Graeme Bell, 2005, Taylor & Francis, ISBN: 978-0-415-36440-9.
- “Design of Small Dams,” 1987, 3<sup>rd</sup> edition, Bureau of Reclamation.
- “Geotechnical Instrumentation for Monitoring Field Performance” by John Dunnycliff, 1993, Wiley, ISBN: 978-0-471-00546-9.

**Class Attendance:** Students should attend all classes to obtain maximum educational benefits. Absence or lateness does not excuse students from required course work. Students must inform the instructor prior to the anticipated absence and take the initiative to make up missed work in a timely fashion.

**Exams:** Dates for the mid-term and final exam dates are provided in the course outline table. Students must take the exams on the scheduled exam dates. No excuses will be accepted except for (1) an incapacitating illness, (2) death in the immediate family, or (3) university-related justification (e.g. students who need to play at official CSU sport club competitions). For excuses (1) and (2), a signed medical note from a doctor (including address and phone number) will be required. For excuse (3), an official CSU letter from the appropriate Team Sport Club Director is required. Failure to take an exam on the assigned date without prior approval of the instructor will result in a score of zero. The final exam will not be comprehensive.

**Homework and Quizzes:** Homework may be assigned on occasion. A due date will be established at the time the homework assignment is distributed. Homework is due at the beginning of class on the due date. Late homework will neither be graded nor collected. Engineering paper must be used, and all diagrams and calculations must be clearly presented to receive credit. Homework solutions may be posted on RamCT after the homework is graded. Pop quizzes may be given in class at any of the regular lecture times during the semester. Failure to take an in-class

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quiz on a given date due to absence from class will result in a score of zero (Exam excuses 1-3 above also apply to in-class quizzes). Quizzes and Homework scores will be averaged to count as 10% of your total course grade.

**Grievances:** You may contest homework, quiz and exam grades in writing only. You should submit a complaint by the next class from the date the graded homework/quiz/exam is returned to you, indicating the item and question in which you believe a grading error was made. Please note that all grades reflect not only the correctness of the solutions but also organization and clarity of presentation.

**Academic Integrity:** While problems of this nature are not anticipated, please be advised that there are penalties and other serious consequences, as described in the Colorado State University Regulations whenever a student is involved in academic dishonesty. For further details on this issue please review the University rules on the following website: <<http://tilt.colostate.edu/integrity/>>

**Instructional Methodology:** The instructional approach for this course includes a combination of lecture, individual assignments, and teamwork exercises. The class will meet as a single group three days a week for lectures.

**Mode of Delivery:** Classroom instruction.

**Methods of Evaluation:** Students will be evaluated on the basis of two examinations (i.e., one mid-term exam and one final exam), an average score for homework and quizzes, and a final project describing the design of a small dam. Projects will be presented to the class during one of the class periods. The final grade distribution will be as follows:

Mid-Term Exam:	30 %
Final Exam:	30 %
Homework & Quizzes:	10 %
<u>Design Project:</u>	<u>30 %</u>
Total:	100 %

Term grades for this course will use the +/- grading system as described in the CSU catalog. The following scale will be used: A  $\geq$  93; A-  $\geq$  90; B+  $\geq$  87; B  $\geq$  83; B-  $\geq$  80; C+  $\geq$  77; C  $\geq$  70; D  $\geq$  60; F < 60.

**Course Outline:**

Week		Topic
1	1/19-1/21	Course introduction.
2	1/24-1/28	1D flow of water through soil: head; Bernoulli's principle; Darcy vs. Forchheimer.
3	1/31-2/4	2D flow of water through porous media: Laplace's equation for 3D; 2D flow nets.
4	2/7-2/11	Flow rate; hydraulic gradient; piping; Herrick's vs. Hazen's liquefaction.
5	2/14-2/18	Pore water pressure distribution; Uplift forces.
6	2/21-2/25	Finite difference solution for 2D flow.
7	2/28-3/4	Flow through earth dams; hydraulic conductivity measurements; soil filtration.
8	3/7-3/11	<b>Mid-Term Exam (Friday, 3/11/11 at 11:00 AM-11:50 AM);</b> Project assignments.
-	3/14-3/18	Spring Break – No classes.
9	3/21-3/25	Types of dams; selection.
10	3/28-4/1	Design principles; design data and criteria.
11	4/4-4/8	Critical state soil mechanics (review).
12	4/11-4/15	Foundation design.
13	4/18-4/22	Embankment design.
14	4/25-4/29	Design examples; small earth dams.
15	5/2-5/6	Project presentations.
16	5/9-5/13	<b>Final Exam (Thursday, 5/12/11 at 9:40 AM-11:40 AM).</b>