CEE 2100: Introduction to Environmental Engineering
Spring 2011
Syllabus

Course Instructor:	Prof. Andres Clarens Virginia Environmentally Sustainable Technologies (VEST) Laboratory Department of Civil and Environmental Engineering, University of Virginia
Office:	D220 Thornton Hall
Email:	aclarens@virginia.edu
Office Hours:	Monday 12-1 PM or schedule a meeting via e-mail.
Lecture:	MWF 11-11:50 AM, OLS 005
Course Credit:	3
Class Website:	https://collab.itc.virginia.edu/ An interactive syllabus (w/ live links to reading, HW, etc) is available on collab
GSI:	Dong Liu (dl3fz@virginia.edu)
GSI Office Hours:	Tuesday, 10-11 AM, Thornton B220
Exam:	Thursday, May 5, 2011, 9 AM

Course Description: “Sustainability” and “green” are two of the buzzwords of your generation. These words reflect widespread and real challenges related to water, natural resources, energy, global health, and population. Engineers **like you** play a critical role in finding strategies to balance civilization’s environmental, economic, and societal needs. Increased demand for sustainability-trained professionals requires that when you graduate from UVa you are competent in the traditional science, technology, engineering, and mathematics AND cognizant of how sustainability relates to your specific interest whether they be building houses or building wind turbines. This course will provide you with the foundation of physical and chemical understanding you will need to think critically about sustainability and green engineering. For those of you interested in environmental engineering as a career this course will create a foundation for future study. For those pursuing a different engineering discipline, it will give you all the tools you need to appreciate and apply the tools of sustainability to your work.

Course Goals: At the end of this semester you will be able to:
- Discuss at least five of the most important environmental challenges facing society today
- Use first-principles mass/energy balances to solve problems associated with these problems
- Solve both closed form and open-ended environmental problems
- Apply critical thinking skills to news stories about environmental problems

Course Mission: The impacts of human activity on the environment are no longer local (solid waste) or regional (wastewater) in scale. Global challenges associated with climate change and resource availability, among others, require that we all minimize our burden on natural systems. To that end, this course will provide the fundamentals needed to practice sustainability. Inherent in this are the traditional skills of environmental engineering including pollutant properties, risk management, transport, transformation, and remediation. To practice sustainability engineering, additional skills in life cycle assessment, pollution prevention, and economic decision-making are required.

Course Objectives

1. Given emissions and resource consumption data for an engineering system, such as a power plant or vehicle, be able to identify possible environmental impact and sustainability issues.
2. Given an exposure pathway for a chemical, be able to compute the acceptable exposure level.
3. Given basic characteristics of an environmental system such as a river, lake, or atmosphere surrounding a city, be able to model the steady and unsteady state concentration of a pollutant using fundamental reactor theory.
4. Given the rate of reaction or partitioning information, be able to compute the fate and transport of a pollutant in air, water, or soil.
5. Given life cycle assessment information for engineering systems, be able to use the information to demonstrate which option is likely to have less significant emissions and energy use.
6. Given information on cash flows related to two pollution prevention or environmental remediation options, use net present value concepts to identify the one with least life cycle cost.
7. Given an environmental quality issue related to pollution, be able to identify possible approaches for mitigating impact.

Text: (required) *Introduction to Environmental Engineering and Science*. By Gilbert Masters and Wendell Ela. ISBN 0131481932; (recommended): *Introduction to Engineering and the Environment.* By Rubin and Davidson; additional readings will be posted to the course website and announced in class. Other complimentary texts are available on reserve at the Brown Science and Engineering Library.

Notes: Your instructor has prepared notes, typically only 1-2 pages for each lecture that you should read BEFORE coming to lecture. Why? Because reading these prior to class will **significantly** improve your understanding of the material and lead to a more fulfilling classroom experience for everyone.

Evaluation of Student Achievement: We will evaluate your progress toward an understanding of environmental problems and ways to model them via two midterm exams, a final exam, weekly homework, and in class participation all weighted equally.

Grades:	Midterms (2)	40% (20% each)
	Final	20%
	Homework	20%
	Participation	20%

Midterms: These in class exams will be on **February 28 and April 20, 2011**. We will provide you with last year's exam so that you can practice. The format of the exam will be 2-3 open ended quantitative questions and ~10 multiple-choice questions testing your general understanding of environmental problems. The exams will be closed book but we will provide you with a detailed equation sheet at the back of the exam.

Final: The final exam (**May 5, 9 AM**) will be similar in format to the midterms but written for 2 hours instead of 1. It will be cumulative but since everything in this class builds on the material before, it will provide you with an opportunity to demonstrate everything you have learned this semester!

Homework: Problem sets are generally due 1 week after being assigned. This semester we are trying a new approach to assigning homework using the online interface *webwork*. The advantage of using *webwork*, is that it will grade your homework on the spot so you will have immediate feedback on how you did in a given assignment. It will also be configured so that you will have three (3) opportunities to try a problem. That is, you can try once and if your answer is incorrect, *webwork* will tell you so and you can try the problem again (except it will change the numbers in the problem). This will allow you to focus on *understanding the process* of solving problems rather than focusing on the particular numerical solution. To learn the material from this course, it is very important that you take the time to carefully complete the homework assignments. For each assignment, start by reading the questions and restating, in your own words, what each problem asks. Many errors occur when there is a discrepancy between what the problem asks and what the student solves. Draw a picture of the problem in your notes when appropriate. Next, list all the information that is given in the problem and any additional information that you obtained from the text or other sources. Only once you've worked through the problem and checked your work should you enter your final answer into *webwork*.

Participation: Your participation grade will be based on clicker response in class as well as small group exercises and the questions you ask in class. Attendance is required at each class session listed on the syllabus. Lecture will begin at 11 AM, and entry after this time is discouraged as a courtesy to your classmates and lecturers. Consistently entering class late or leaving class early will have a negative impact on your attendance grade, so please communicate with Professors Clarens prior to class if attending any full lecture will be a problem for your schedule. Of course, good reasons to miss lecture come up from time to time and therefore you will be allowed 3 unexcused absences during the semester. If you have 4 unexcused absences during the semester, you will lose 1% of your course grade. Each additional unexcused absence will reduce your course grade by 0.25%. While we do have a large class, it is also expected that you will participate fully in the lectures. I will do my best to learn all your names, but please be patient and remind me when you have an opportunity.

Honor Policy: The University of Virginia relies upon and is widely known for its community of trust. In this course we will adhere to all of the rules of the University of Virginia Honor System. All graded work should be pledged in the spirit of the honor system. "On my honor, I pledge that I have neither given nor received help on this examination (assignment, etc.)". The student should sign the pledge. The instructor strongly endorses the principles upon which the System is built, namely, that students not lie, cheat or steal. Students are welcome to discuss problem sets with other students in the class. However, the written work must be your own. You may not discuss problem sets with members of previous classes, or make use of solutions prepared in previous semesters. This will be treated as a violation of the honor code.

Lecture Plan

Section	Date	Topic	Reading	Homework*
Part 1: Environ. Challenges	19-Jan	Course overview		
	21-Jan	Environmental footprint and the role of engineers	Handout, podcast	
	24-Jan	Risk assessment	M&E p127-146	
	26-Jan	Risk assessment and standards	M&E p146-166	
	28-Jan	Environmental laws and regulations	Website	HW#1a
Part 2: Environ. Systems	31-Jan	Units; flow v flux	M&E p2-6	
	2-Feb	Mass balances and residence time	V&M p26,28	
	4-Feb	Steady state w/ conservative pollutants	V&M p45-60	HW#1d,2a
	7-Feb	Non steady-state w/ conservative pollutants	V&M p61-66	
	9-Feb	Reaction Kinetics	M&E p57-76	
	11-Feb	Steady state w/ nonconservative pollutants	V&M p84-93	HW#2d,3a
	14-Feb	Non steady-state w/ nonconservative pollutants	V&M p95-105	
	16-Feb	Comparison of Reactors: Batch, PFRs, CMFRs	V&M p106-115	
	18-Feb	Review material balance equations		HW#3d,4a
Part 3: Water Pollution	21-Feb	Water treatment processes	M&E p289-316	
	23-Feb	Partitioning: Organic Liquid:Water (Solubility); Air-Water (Henry's Law)	N&A-C p95-100	
	25-Feb	Partitioning Including Solids: Isotherms	N&A-C p100-104	HW#4d
	28-Feb	Review Exam #1		
	2-Mar	EXAM #1		
	4-Mar	Drinking water treatment in developing countries		
	14-Mar	VOC Remediation: Activated Carbon	N&A 333-336	
	16-Mar	Water pollution and BOD	M&E p173-189	
	18-Mar	DO and Streeter Phelps	M&E p199-218	HW#5a
Part 4: Air Pollution	21-Mar	Green Building and LEED	M&Z 632-641	
	23-Mar	Energy balances		
	25-Mar	Automobiles and the Environment	M&E p401-426	
	28-Mar	Energy and the Environment	R p162-196	HW#5d,6a
	30-Mar	Environmental Controls on Power Production	M&E p426-438	
	1-Apr	Principles of Ozone Depletion	M&E p574-587	
	4-Apr	Gaussian Plume Model of Air Transport	M&E p437-461	HW#6d,7a
	6-Apr	Line Source Dispersion Model of Air Transport	M&E p461-470	
	8-Apr	Global Warming – Introduction		
	11-Apr	Global Warming – Chemistry	M&E p501-530	HW#7d
	13-Apr	Global Warming – Climate Forcings and Temperature Change	M&E p533-575, podcast	
Part 5: Life Cycle and Green Design	15-Apr	Introduction to Life Cycle Assessment	R p281-300	
	18-Apr	Life Cycle Assessment Examples	R p300-313	HW#8a
	20-Apr	Review		
	22-Apr	EXAM #2		
	25-Apr	Time Value of Money	R p 544-570	
	27-Apr	Cost-Benefit Analysis	R p 571-583	HW#8d
	29-Apr	Global Trends		
	2-May	Course Wrap up and review for exam		
			*a=assigned,	d=due