Appendix D. Course Syllabi

50. Solar Systems Engineering

University of Massachusetts, Lowell

SUMMARY

Offered by: Mechanical Engineering and Energy Engineering
Instructor(s): John Duffy

Number of times taught: Three or More
Class size: 10 to 30
Class format: on-line

Portion of course focused on sustainable engineering: More than 50%

Student Level: Graduate and upper division (7:3)
Students' Major: information not provided

SOLAR SYSTEMS ENGINEERING (22.527)

Spring 2008 (Draft)

INTRODUCTION

Welcome to the Solar Systems Engineering course. This course was developed by the Solar Engineering Graduate Program at University of Massachusetts Lowell (http://energy.caeds.eng.uml.edu). This is an on-line course. The instructor of the course is Dr. John J. Duffy, Professor and Coordinator of the Solar Engineering Graduate Program (John_Duffy@uml.edu; 978-934-2968). These lessons are based on class notes and have been transcribed into word processor files, including original figures, by Juan Pablo Trelles and Peter Aurora. [I am grateful for their efforts—JJD.] The notes have been based on various textbooks, papers, web pages, and personal experience. References are given in appropriate chapters in this set of course material. This set of course materials is hereby copyrighted ©2006.

The course will allow you to have an on-line interaction with the Solar Energy Program at UML. Because this is an on-line course, you can follow it according to your own schedule, to fit in with your professional and personal time commitments. Homework is due each Thursday (tentatively) following the week indicated for each lesson. The due dates are indicated in parentheses in the online syllabus. For example, the homework for Week 1 is due January 31 via e-mail to the instructor. (Please use the format: hw1.1-*name*.mcd, where *name* is your name or initials and 1.1 is the section number of that homework.) At the end of each chapter you are asked to answer a number of questions to test your comprehension of the material in the chapter. You must answer these successfully in order to proceed to the next chapter. Feel free to ask questions of the instructor (John_Duffy@uml.edu) and to suggest alternative topics for the course.

OUTLINE (tentative, depending on student interests)

Photovoltaics
- Qualitative principles
- Applications
- Quantitative Analysis
- Systems
- Design
- Sizing
- Simulating
- Loss-of-load probability

[Review of probability theory]
Random process models

Passive Solar
Thermal network models, hourly performance prediction
Simulation-design tools, monthly average prediction

Economic Analysis
Life-cycle savings

Fuel Cells and Electrolyzers with PV
Principles of operation
Sizing and matching components

Daylighting
Qualitative
Design tools

LEARNING OBJECTIVES (tentative):
By the end of this course, the student will be able to:

- explain the principles of operation of a silicon photovoltaic (PV) cell
- form a mathematical model of the I-V characteristics of a PV cell
- connect PV modules in such a way as to match a required load or battery voltage
- size a PV array and storage standalone system for a given load requirement, geographical location, and loss-of-load probability
- explain the operating principles of PV balance-of-system components (batteries, battery chargers, inverters)
- explain the operating principles of the four most common passive solar systems
- formulate mathematical models of the thermal performance of simple passive solar systems
- predict the solar fraction of the space heating load of a building supplied by a given passive solar system in a specified geographic location
- explain and calculate key economic figures of merit of solar systems: rate of return, life-cycle savings, and payback time
- match appropriate daylighting systems to a given building requirement
- explain the principles of operation of PEM fuel cells and electrolyzers
- size a simple PV, electrolyzer, H_2 and O_2 storage, and fuel cell system to meet a given daily load.

INSTRUCTOR: John Duffy, E332, 978-934-2968, John_Duffy@uml.edu.

PREREQUISITES: Differential equations; heat transfer

RECOMMENDED TEXTS:
Since this is an online course, the notes provided should be sufficient, but if you want supplementary text:
Goswami, Kreith, and Kreider, 2000, *Principles of Solar Engineering*, Second Edition, Taylor and Francis, Philadelphia.
You are expected to read the following book as part of the course:
Komp, R.J., 1995, *Practical Photovoltaics, Electricity from Solar Cells*, Aatec Publications, Ann Arbor, MI.

MINIPROJECT:
(Tentative) Solar modular bathrooms for Tahono O'odham Reservation in AZ. More information later.

There will be two tests and a final exam at predetermined times during the semester. We will poll the class to make sure everyone will be available during the times of the tests. Unfortunately, we need to assign grades for this course. There are no predetermined percentages of students that will receive A, B, etc. We try to have objective standards. Therefore, there is no competition among students for grades. We try to have cooperative learning in this course, in which we help each other learn. There will be a group project, in which you will work with at least one other person in the course to apply the principles learned in the course on a "real" problem.

GRADING:

Two tests	20% each
Homework	10%
Miniproject	20%
Final exam	30%

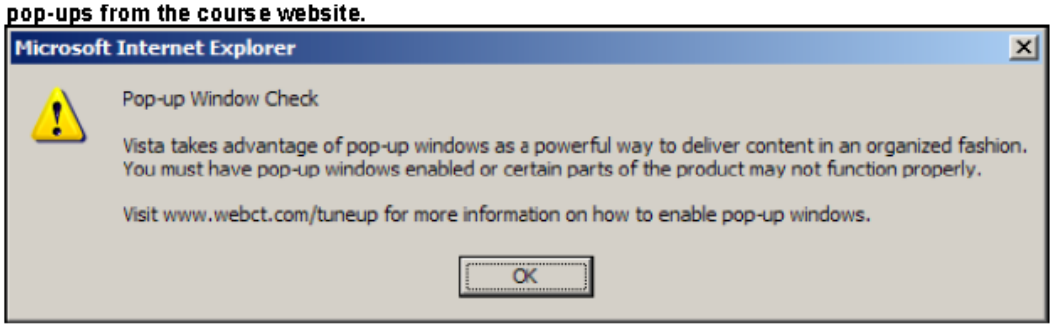
ADDITIONAL HELPFUL READING:
Green, M.A., 1992, *Solar Cells*, Univ. New South Wales, Kensington, NSW.

Blackboard Vista Access Information
To get your Blackboard Vista username and password:
1. Go to http://continuinged.uml.edu/online and click on **Get Your Online Course Username/Password** link.
2. Follow on-screen instructions carefully to enter the information required to retrieve your username and password.
3. Print out the confirmation screen for your records.

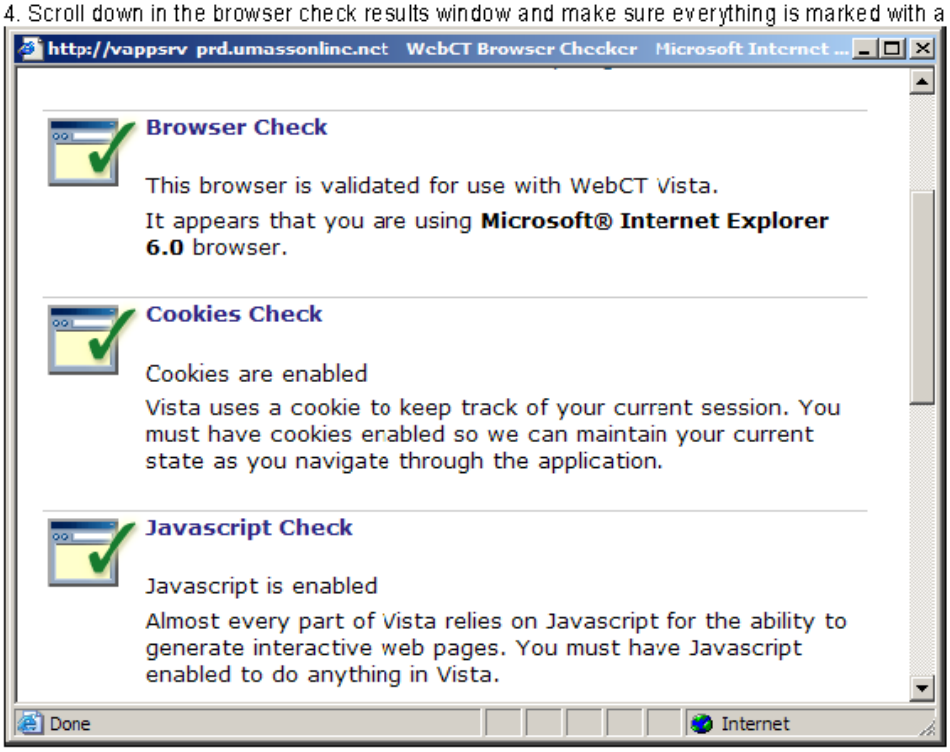
4. To access the online supplement for your course, go to http://continuinged.uml.edu/online , click and enter your username and password.

Important steps to complete when you first login

1. When you first log into Blackboard Vista, pay particular attention to the warning messages that may come up. If you see a warning message about pop-up windows being disabled (similar to the one shown below), **you must turn off all pop-up blockers on your computer in order to use Blackboard Vista or allow pop-ups from the course website.**



2. If you get a **Java Security Certificate Warning** message, make sure to first check the box next to **Always trust content from this publisher**, then click the **Run** button.
3. Do a browser check by clicking on **Check Browser** link at the top right of the screen.
4. Scroll down in the browser check results window and make sure everything is marked with a green check:



5. If you see anything with a red X next to it, scroll down to the bottom of the window and click on **Step-by-step instructions to properly configure your browser** link.

How to get technical help

If you're having problems with Blackboard Vista, please contact Continuing Education Online Learning technical support:
Monday - Friday 8:30am - 5:00pm EST
Local Phone Number: 1-978-934-2467
Toll Free Number: 1-800-480-3190

Saturday, Sunday, Holidays and Monday - Friday 5:00pm - 8:30am EST
Toll Free Number: 1-800-569-6505

Steps to log into the course site (note we have switched from IntraLearn to WebCT or Blackboard) and more detailed instructions below:

1. Open your Internet connection (Explorer, Netscape, etc…)
2. In the URL Location/Address space type or paste:
   https://vappsrv-v4.umassonline.net/webct/entryPageIns.dowebct
3. Click on the "U Mass Lowell" button. Then "Log In."
4. Enter your username and password. Click on the "Log on" button.
5. Click on the name of your course.
6. Click the "Begin" button, located on the upper right corner.

If you encounter any technical problems with the WebCT (Blackboard) software, please contact Li Feng via e-mail Li_Feng@uml.edu or at 978/934-2927.

51. Sustainability Concepts and Methods

University of South Florida

SUMMARY

Offered by: Environmental and Occupational Health, Civil and Environmental Engineering, and Geography
Instructor(s): Amy Stuart, Maya Trotz, and Fenda Akiwumi

Number of times taught: Once
Class size: Less than 10
Class format: 2 hours of lecture plus 1 hour of lab per week

Portion of course focused on sustainable engineering: 25 to 50%

Student Level: Graduate
Students' Major: 80% Environmental and Occupational Health, Civil and Environmental Engineering, or Geography
20% Other non-engineering

Syllabus

Sustainability Concepts and Methods: Mercury in Tampa Bay

PHC 6934 (ref# 15933) / CNG 6933(ref# 11277) / Geog 6119 (ref # 18993)

Spring 2008

Course Description: An interdisciplinary introduction to the concepts of sustainability and research methods for studying sustainability. The case focus of the course will be mercury in the Tampa Bay area.

Objectives: Upon completion of this course the student should be able to:

1) Discuss different perspectives on sustainability and identify aspects that affect sustainability (of a project, problem, etc).
2) Identify and integrate research approaches (and/or experts) across disciplines.
3) Identify and conduct some environmental sampling and analysis methods for Hg.
4) Describe mercury speciation and cycling.
5) Discuss the value (and limitations) of environmental sampling and analysis.
6) Design and implement a simple population survey.
7) Discuss the value (and limitations) of population survey methods.
8) Apply simple systems modeling to an environmental problem.
9) Discuss the value (and limitations) of systems modeling.

Pre-Requisites: College Calculus, College Chemistry

Credit Hours: 3 units

Dates / Times: MW 2 - 3:30. January 7 to April 23

Location: NES 103

Format: Face-to-face classroom instruction, laboratory and field experiences

Attendance / Participation: Students are expected to regularly participate in the class through asking and answering questions. If you do not attend, it is not possible to participate.

Instructor Information:

Name:	Amy Stuart, PhD	Maya Trotz, PhD	Fenda Akiwumi, PhD
Office	COPH 1116	ENG 220	NES 314
Office Hours	T, Th 3 - 4:30 pm	T 3-5 pm, W 10-11:30 am (tent.)	T, Th 1 - 2:30 pm
Phone	974-6632	974-3172	974-6887
Email	astuart@hsc.usf.edu	matrotz@eng.usf.edu	fakiwumi@cas.usf.edu

Preferred method of contact: The instructors' preferred method of contact is face-to-face during office hours (to be announced during the first week of class). We will also respond to email and phone messages on a limited basis. Reply times may vary up to several days.

Course Outline:
(Tentative)

It is recommended that students read the materials listed *before* the given lecture. Reading lists will be provided for each topic.

Part 1: Sustainability Concepts

Week 1 (Jan 7, 9): Introduction and concepts (Stuart)

- Syllabus review and Institutional Review Board (IRB), (Jan 7)
- Definitions and perspectives, Components (environmental, economic, social/cultural), Human connections to the physical and natural world, Spatial and Temporal scales, Equity issues (Jan 9)

Week 2 (Jan 14, 16): Methods, tools, and case studies

- Life cycle assessment (industrial ecology), Footprint calculators, Eco indicators, Target plot (Jan 14, Trotz)
- Case Studies and class project planning (Jan 16, Akiwumi)

Project Planning: During week 2, the class will be divided into groups for work and writing on the final class project on Tampa Bay Hg. The tentative group is below.

- Group 1: Introduction, Motivation, and Discussion sections
- Group 2: Methods, results, discussion for environmental sampling and analysis
- Group 3: Methods, results, discussion for population surveys
- Group 4: Methods, results, discussion for system modeling

Part 2: Environmental Sampling and Analysis (Trotz)

Week 3 (Jan 23): Hg occurrence and fate

- Hg species, Hg biogeochemistry, Fate in various samples (biota, soil , water, air, hair, blood, urine)

Week 4 (Jan 28, 30): Analytical Methods for Hg determination

- Emphasis on AFS, AA, Total, inorganic Hg

Week 5 (Feb 4, 6): Experimental Methods

- Safety procedures, Taking field samples (water, sediment), Processing field samples in the laboratory, Analyzing field samples for Hg

Week 6 (Feb 11, 13): Laboratory Analysis

There will also be two required 3-hour labs and one field sampling trip to be completed in coordination with instructor.

Part 3: Population Survey Methods (Akiwumi)

Weeks 7 (Feb 18, 20)

- Methods (quantitative, qualitative and mixed methods) and theory in research, The survey research method, the questionnaire as survey instrument

Weeks 8 (Feb 25, 27)

- Risk perception theory, fishing, fish contamination and risk perception (readings)

Weeks 9 (Mar 3, 5)

- Population surveys – field data collection

Weeks 10: Spring Break - No class

Weeks 11 (Mar 17, 19)

- Collation and analysis of data

There will also be two required 3-5 hour field data collection trips to be completed in coordination with instructor.

Part 4: Systems Modeling (Stuart)

Week 12 (Mar 24, 26): Systems Thinking

- What is a system? Big-picture thinking. Emergent properties. System as the cause. Temporal dynamics. Interdependency, feedbacks, non-linearity. Systems behavior and outcomes modes.

Week 13 (Mar 31, Apr 2): Modeling Basics

- What is a model? Conceptual and box diagrams. Conservation principles. Stocks and flows. Scale and units. Rates of change.

Week 14 (Apr 7, 9): Model Building

- Representing model building blocks. Connecting variables and subsystems. Spatial arrays. Time behavior. Parameter estimation. Overall work flow diagram

Week 15 (Apr 14, 16): Model Testing and Application

- Face validity. Conservation and units check. Numerical error testing. Sensitivity and uncertainty analyses. Benchmarking. Evaluation. Results analysis.

Meetings: Monday classes with be lecture style and will meet in the lecture room. Wednesday classes with be hands-on computing skills labs with STELLA, and will meet in the computer room (ENB 228).

Part 5: Wrap-up

April 21 Final wrap-up discussion; Team work to finish projects

April 23 Project presentation by students; Student survey for course assessment

April 30 ***Final class project due***

Reading Materials:

Required Text: Simon Dresner. *The Principles of Sustainability*. Earthscan Publications Ltd. 2002 (Available in the main university bookstore and the health sciences bookstore.)

Other reading materials will be provided via blackboard, library course reserve, or as class handouts (at the discretion of the instructors).

Grading:

Scale:

Class Participation:	20%
Project Participation, Writing, and Presentation:	40%
Individual Assignments and Quizzes	40%

The course will be graded on a curve, with natural divisions in the earned scores leading to divisions in the letter grades. + and – grades will be used in this course.

Types of Assessments:	Class participation: We expect all students to regularly participate in the class through asking and answering questions, discussing content, and being present and involved in laboratory and field work. Project participation, writing, and presentation: Each student is expected to enthusiastically and professionally contribute to the team project through research, writing, and presentation. Individual Assignments and Quizzes: There will be regular homework assignments and quizzes over the course of the semester. Safe-Assignment and other plagiarism checking methods may be used to ensure academic honesty.
Late and Make-up Policies:	Students are expected to turn in assignments on time and to be present to participate in the laboratories, field surveys, and to take quizzes. If you cannot be present for the scheduled dates, you should inform the instructor as soon as possible, so that alternate arrangements can be made. Some university regulated excuses include disability-related conditions, observance of major religious holidays, and official participation in university-sponsored athletic events. Students who anticipate missing an exam for these reasons should provide the official paperwork or written notice (for religious observance) by the second class meeting. If you miss a class or anticipate missing a class, you should contact a fellow student to get any needed information or announcements of assignment or quizzes.

Other Classroom and University Policies:

Academic Dishonesty and Disruption of the Academic Process:	Academic dishonesty or disruption of the academic process in any form, including plagiarism, will not be tolerated. See the following for a discussion of forms and consequences, at http://www.sa.usf.edu/handbook/academics/ImportantAcademicPolicies.htm or http://catalog.grad.usf.edu/currentpdf/USF_Graduate_Catalog_2005_2006_section6.pdf
Permission to Use Lectures:	Materials generated for this class may be copyrighted. You may make single copies for your personal scholastic use, in accordance with U.S. copyright law. Any other reproduction or dissemination is forbidden without prior express permission from the copyright holder. Lectures may not be recorded without prior permission of the instructor.
Americans with Disabilities Act (ADA):	The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. If you have a disability requiring an accommodation, you should contact the USF Office of Academic Support and Accommodations for Students with Disabilities to apply for services. Services offered are discussed at http://www.asasd.usf.edu/index.htm
Student Handbook:	http://www.sa.usf.edu/handbook/
Student Conduct:	USF Student Rights/Responsibilities: http://www.sa.usf.edu/handbook/rights/StudentRightsResponsibilities.htm USF Student Code of Conduct: http://www.sa.usf.edu/handbook/rights/StudentCodeofConduct.htm
Holidays and Religious Observances:	http://www.sa.usf.edu/handbook/policies/ReligiousPracticesPolicy.htm

Additional Resources for Students:

Library Resources:	'How to Find a Journal Article': http://itt.usf.edu/publichealth/library/tutorial/index.html
	USF Library Resources and Services: http://www.lib.usf.edu/
	Shimberg Health Sciences Library: http://hsc.usf.edu/library/
Plagiarism:	Tutorial on Plagiarism for Students: http://www.cte.usf.edu/plagiarism/plag.html
Creating Citations:	http://web.lib.usf.edu/usflibraries/help-styleguides.html
Using Bibliographic Management Software:	http://itt.usf.edu/publichealth/library/bms/bms_v5_interface.html

52. Sustainable Design

Dartmouth College

SUMMARY

Offered by: Engineering
Instructor(s): Benoit Cushman-Roisin, Peter Robbie and Karolina Kawiaka

Number of times taught: Three or More
Class size: 10 to 30
Class format: 4 hours of lecture per week plus significant amounts "other" types of contact (projects, field trips, etc.)

Portion of course focused on sustainable engineering: More than 50%

Student Level: Upper division and graduate (7:3)
Students' Major: ≥90% Engineering

DARTMOUTH COLLEGE
THAYER SCHOOL of ENGINEERING
ENGS 44: Sustainable Design

Design for pollution prevention should be a key feature of the education of the next generation of engineers. (Sheldon K. Friedlander, National Academy of Engineering, 1994)

The next industrial revolution is the design revolution. (...) Let's design buildings, products, cities--literally everything--so no harm is done. (William McDonough, 2000)

The only way to make change is to make that which you hope to change obsolete.
(Buckminster Fuller)

An interdisciplinary introduction to the principles of design for sustainability, with emphasis on the built environment. Through lectures, readings, discussions, and a major design project, students will learn to design buildings and other infrastructure with low to no impact on the environment. Emphasis is on creative thinking, strategies for managing the complexity of the product life-cycle of the infrastructure, and the thorough integration of human and economic aspects in the design. Homework and project activities provide practice in relevant engineering analyses.

Prerequisites: ENGS-21 (Introduction to Engineering), and
ENGS-22 (Systems) or SART-65 (Architecture 1)
Distributive type: TAS (Technology & Applied Science).
Enrolment cap: 20

Instructors:

Benoit Cushman-Roisin (environmental engineering)
Peter Robbie (product design)
Karolina Kawiaka (architecture)

Teaching assistants:

Ian Graves
Jessica Kahn
Eric Klem
Drew Wenzel

Textbook: (required)

The HOK Guidebook to Sustainable Design, 2nd edition, by Sandra Mendler, William Odell and Mary Lazarus, John Wiley & Sons, 2006

Other resources:

Sustainable Construction – Green Building Design and Delivery, by Charles J. Kibert, 2nd edition, John Wiley & Sons, 2008.
Okala Ecological Design, course guide by P. White, L. St.Pierre and S. Belletire, 2004
The Next Industrial Revolution, William McDonough, Michael Braungart & the Birth of the Sustainable Economy, Bullfrog Films, 2001

Other student activities:

Critical readings (weekly, leading to in-class discussions)
Homework (building insulation, passive-solar design, photovoltaic cells, life-cycle analysis of small objects, LEED audit of campus buildings)
Site visits

Grading:

15% Homework
10% Reading critiques (1 reading per week)
75% Main project
- 40% weekly assignments/presentations
- 10% wiki contributions
- 25% final presentation

100%

53. Sustainable Design Technology and Environmental Systems

University of Michigan

SUMMARY

Offered by: Mechanical Engineering
Instructor(s): Steve Skerlos

Number of times taught: Three or More
Class size: 30 to 100
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Graduate and upper division (9:1)
Students' Major: 30% Mechanical Engineering
50% Other engineering
20% Non engineering

Sustainable Design
Technology and Environmental Systems
Mechanical Engineering ME589

Instructor: Professor Steven J. Skerlos (skerlos@umich.edu)

Director, Environmental and Sustainable Technology (EAST) Laboratory

Department of Mechanical Engineering

The University of Michigan at Ann Arbor

3001E EECS Building

www.umich.edu/~skerlos

Office Hours: 5-6:30 Wed and 4:30-6pm Thurs

GSI: Ms. Tanna Borrell

Office Hours: 10-11 AM and 5-7 PM on Mondays

Credit: 3 Credits.

Mission: To make clear the grand challenges driving the need for sustainable design, and to provide tools and examples useful for tomorrow's engineers to meet them.

Objectives: Describe grand challenges technology poses for water, energy, and climate change along with the incentives and inhibitors to implementing sustainable design to meet these challenges.

Teach modeling approaches for estimating impacts of technology design choices on water pollution, air pollution, and global warming potential.

Introduce life cycle assessment and predictive life cycle assessment as concepts along with software tools that facilitate their practice.

Learn about sustainable design case studies that focus on the spectrum of product life cycle stages, as well as integrated end-use design, transportation, manufacturing, and consumer products that demonstrate sustainable design principles.

Complete a design project that has a positive impact on sustainability research, education, or practice in a domain of significant societal importance.

Grading :

Midterms 2x20% each

Final 20% (optional, replaces lowest midterm)

Term Project 30%

Homework Assignments 20%

Class Participation 10%

Term Project:

A group project will be assigned early in the semester that will investigate a specific topic related to the sustainable design of technology systems. The project is intended for the general public, engineering practice, or academia. It will be made public in an appropriate form. Projects will be graded regarding their potential for impacting research, practice, and/or education in the sustainable design of technology systems. Some possible topics will be suggested early in the semester.

54. Sustainable Engineering

Oregon State University

SUMMARY

Offered by: Engineering Science
Instructor(s): Alex Yokochi and Ken Williamson

Number of times taught: Three or More
Class size: 30 to 100
Class format: 3 hours of lecture plus 1 hour of discussion per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Undergraduate, upper and lower division (3:1)
Students' Major: ≥90% Engineering

ENGR 350: Sustainable Engineering

INSTRUCTOR: Dr. Alexandre Yokochi
Office: 207 Gleeson Hall
Phone: 737-9357
email: alex.yokochi@orst.edu
Office hours T,W,Th 13:00 – 14:00 or by appointment

CLASS SCHEDULE: Tuesday 14:00 – 17:00

TEXTS: "The Skeptical Environmentalist" by Bjørn Lomborg. (Cambridge University Press, Cambridge: United Kingdom, 2001. ISBN 0-521-01068-3)

"Science Magazine's State of the Planet 2006-2007" by Donald Kennedy (Editor). (Island Press, Washington, D.C.: Unites States of America, 2006. ISBN 1-59726-063-0)

Additional materials to be handed out in class if desirable/necessary.

Class Description & Goals:

Examination of the concept of sustainability and of the main issues professionals in the fields of engineering are likely to face in the course of their careers. It is probably impossible to obtain a non-subjective understanding of sustainability but we will examine the issues from the most rational perspective that we can manage.
Generally we will examine the available scientific data, investigate the positions taken by the 'experts' on both sides of an issue, and explore the issues by discussion in class. The latter activity will form a significant portion of the class. Some review of possible technological innovations and alternatives required to maintain human quality of life and environmental sustainability will be pursued.
Please note that these topics are rife with political implications at every level. We will attempt to focus our attention on the technical issues to the degree possible. Deliberately disruptive behaviour whilst discussing such matters (see below) will not be deemed acceptable.

Learning Objectives: At the end of the course, each student should be able to:

1. Provide a personal definition of sustainability.
2. Discuss the environmental, economic, and social elements of sustainability.
3. Describe how the global cycles of major elements fit into the concept of sustainable development.
4. Describe the important issues related to sustainability in the areas of land use, energy production and use, industrial production, waste management, and water.
5. Discuss the manner in which sustainability related matters fit into our future ability to improve human welfare globally.

GRADING

Evaluation will be based on class projects, quizzes and a final project, as well as active class participation. There is no mid-term or final currently planned. At the instructor's discretion, one can be added if it appears that the class would be best served by a final.
The current breakdown (subject to modification if exams are added to evaluation) is as follows:

Participation:	10%
Weekly Quizzes:	30%
Homework:	30%
Final Project:	30%

If you MUST miss a quiz/other evaluation event for a valid reason (according to me) please discuss it with me as soon as possible.

Homework

Homework will provide opportunities to further explore issues broached in class. Homework should be done in several sittings; you cannot expect to be successful doing homework quickly the night before it is due.
You may discuss homework assignments with your classmates, NOT COPY THEIR SOLUTIONS! Additionally, solutions must be written up independently. Unless otherwise stated by the instructor, you are not allowed to look at to previously worked solutions of the assigned problems (e.g., from previous years, the Web, etc.), before the homework due date. Using such unauthorized sources will be considered as a case of academic dishonesty.

Final Project

The final project will be assigned during week 7 of the term. Each student will work independently to assess important sustainability issues related to a geographical part of the world. The deliverable for this project will be a written report due during dead week.

Late Assignment Policy

Assignments should be submitted by the announced deadline. Late work will be marked down 10%, but can be turned in any time before the assignment is graded. Legibility and neatness will be assessed at grading time.

Disruptive Behavior

While the University is a place where the free exchange of ideas and concepts allows for debate and disagreement, all classroom behavior and discourse should reflect the values of respect and civility. Behaviors which are disruptive to the learning environment will not be tolerated. As your instructors, we are dedicated to establishing a learning environment that promotes diversity of race, culture, gender, sexual orientation, and physical disability. Anyone noticing discriminatory behavior in this class, or feeling discriminated against should bring it to the attention of the instructors or other University personnel as appropriate.
Specific examples of innapropriate behavior include:

- The use of cell phones or pagers in class
- The use of Laptops or other electronic devices for activity outside of assigned use in THIS class (i.e, surf the web, email, pictures)
- Reading the Barometer during class
- Eating during class

Cheating and Student Conduct:

The instructors of this class take the issue of academic honesty very seriously. You are expected to be honest and ethical in your academic work. There is a "zero tolerance" policy in effect for cheating in this class. Any instance in which a student is caught cheating will be handled in strict accordance with the policies outlined at http://www.orst.edu/admin/stucon/achon.htm. In order to provide students with a positive learning environment, OSU has adopted a pledge of civility, which can be found at http://osu.orst.edu/admin/stucon/index.htm.

Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- Cheating- use or attempted use of unauthorized materials, information or study aids
- Fabrication- falsification or invention of any information
- Assisting- helping another commit an act of academic dishonesty
- Tampering- altering or interfering with evaluation instruments and documents
- Plagiarism- representing the words or ideas of another person as one's own

When evidence of academic dishonesty comes to the instructor's attention, the instructor will document the incident, permit the accused student to provide an explanation, advise the student of possible penalties, and take action. The instructor may impose any academic penalty up to and including an "F" grade in the course after consulting with his or her department chair and informing the student of the action taken.

Attendance

Attendance is MANDATORY! You are expected to attend every class and participate in discussion. There will be daily Concept Tests (i.e., quizzes) that will form part of the course evaluation scheme. Completion of all Concept Tests will result in full Class Attendance credit (even if the answer given to the questions posed are incorrect). If you are not able to make class, notify the instructor before class. Unexcused absences may lower your final course grade. If you do miss class, it is your responsibility to find out what was covered and any administrative information that was discussed.

Disability

"Accommodations are collaborative efforts between students, faculty and Services for Students with Disabilities (SSD). Students with accommodations approved through SSD are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through SSD should contact SSD immediately at 737-4098."

The schedule will be (subject to modification if deemed useful/necessary):

1 Introduction to Sustainability: The 3 E's and Sustainable Development

What is 'sustainability'? What are the central themes of sustainability, and why should we care? How do the concepts of sustainability apply to our Environment, the Economy, and notions of Equity? Is poverty important?

2 Population and the World Predicament

Population growth, is there enough food and water? The role of poverty in sustainability, sustainability of our western lifestyle. The global predicament, population and growth, and the distribution of "stuff".

3 Global Cycles

Global elemental and energy cycles; the hydrologic cycle; cycles of human-made chemicals.

4 Global Change

Is the global climate changing? If so, is it because of human actions? Is global climate change a bad thing?

5 Sustainable Energy

Current energy uses and sources; sustainable and renewable energy; fuel cells and hydrogen…

6 Sustainability and the Hydrologic Cycle

Is there enough water for everyone? What are the issues surrounding the sustainability of water? Is the West in a water shortage?

7 Sustainable Agriculture: Can there be enough food?

The modern agricultural complex: Are current methods sustainable? Is organic more sustainable? What about genetically modified crops? What are the issues surrounding biodiversity, and why should we care?

8 Transportation and Urban Environment

What does 'sustainable transportation' mean? Is the current transportation model 'sustainable'? How would the exhaustion of fossil fuels change the picture? What is 'green design'? How does 'green design' affect consumer behavior? How can engineers learn to incorporate ideas of sustainability into their toolbox? What kind of interest is there in green building?

9 Global Policies on Sustainability and the Future...

Is there hope (or even need...) for creating a sustainable future? What is the role of government?

55. Sustainable Engineering

University of Florida

SUMMARY

Offered by: Materials Science and Engineering
Instructor(s): Luisa Amelia Dempere

Number of times taught: Three or More
Class size: 30 to 100
Class format: 1 hour of lecture per week

Portion of course focused on sustainable engineering: information not provided

Student Level: Undergraduate, lower and upper division (9:1)
Students' Major: 20% Materials Science and Engineering
70% Other engineering
10% Non engineering

Sustainable Engineering
(1 Credit)

Course Description: Provide a global perspective of sustainable engineering solutions and their social, economic, and environmental impacts. Review of the traditional engineering decision making process and the modifications needed to implement or improve the sustainability of our engineering selections and decisions.

Course Objectives:

a. Introduce students to engineering disciplines and relationships including societal and environmental factors in the engineering selection and design process.
b. To develop a fundamental understanding of the environmental impact of engineering decisions and how it is assessed, responsible regulatory agencies, and some of the governing standards, rules, and regulations.
c. To develop a fundamental understanding of the societal impact of engineering decisions, how it is assessed, regulatory agencies responsible, and some of the governing standards, rules, and regulations.

By the end of this course, you should be able to do the following:

a. Identify and understand key global social, economic, and environmental factors that do or should impact the engineering decision process.
b. Suggest ideas to effectively incorporate engineering sustainability into the engineering decision making process.

Instructor: Dr. Luisa Amelia Dempere
107J MAEC
Major Analytical Instrumentation Center
Materials Science and Engineering
E-mail: ldemp@mse.ufl.edu
Phone: 392-6985

Course Topics:

- Sustainable vs. Green Engineering
- Sustainability approach in Engineering fields
- Global Warming and Earth Pollution
- Environmental and Societal Impacts
- Shifting to Global and Sustainable Engineering Decisions
- Engineering Case Studies

Grading:

Class Assignments 60%
Final Exam Paper 40%

Class Meetings: Thursday, Period 3th, Rinker Hall 110
References: Will be provided during class.
Class Attendance: Attendance and active participation at all scheduled lectures is mandatory.
Special Accommodations:
Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.
University's Honesty Policy:
Students are responsible for reading and abiding by the University's honesty policy regarding cheating and use of copyrighted materials. Details of the honesty policy maybe found at http://www.dso.ufl.edu/stg/.

56. Sustainable Engineering

University of the Pacific

SUMMARY

Offered by: Civil Engineering
Instructor(s): Camilla Saviz

Number of times taught: Twice
Class size: 10 to 30
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Upper division
Students' Major: 60% Civil Engineering
40% Other engineering

CIVL 193 - SUSTAINABLE ENGINEERING
Spring 2008

Camilla M. Saviz, Ph.D., P.E.
208 Anderson Hall
(209) 946-3077
csaviz@pacific.edu

CLASS: 5 - 6:30 M W 205 Khoury Hall

OFFICE HRS: M 2 – 4 p.m.; Tu 1:30 – 3 p.m.; W 11 a.m. – noon and 2 - 4 p.m.
or by appointment (call, e-mail, or ask), walk-ins welcome whenever my door is open

TEXTS: ASCE Committee on Sustainability, Sustainable Engineering Practice, An Introduction, ASCE, 2004.
Dolan, Paul. True to our Roots, Bloomberg Press, NY, 2003.

REFERENCE TEXT: Hendrickson, C., L. Lave, and H. S. Matthews. Environmental Life Cycle Assessment of Goods and Services, an Input-Output Approach. RFF Press, Washington, D.C., 2006.

COURSE WEB PAGE: Course information, assignments, readings, etc. will be posted on the course web site: http://www.pacific.edu/eng/courses/civl/civl193/

Some assignments will be submitted via Blackboard: pacific.blackboard.com

COURSE OBJECTIVES:

Upon completion of this course you should be able to:

- Identify and explain concepts of sustainability, appropriate technology, etc. in the context of engineering at the global, industrial., and local levels.
- Identify applicable State and Federal resources and regulations and their identify their impacts on design and management.
- Perform a Life Cycle Assessment on an engineered product
- Complete a sustainability analysis on a campus unit
- Use sustainability concepts to complete an engineering design
- Function effectively within a multi-disciplinary team
- Communicate effectively in written and oral formats

COURSE GRADING

The course will be graded as follows:

Assignments	25%
Quizzes	25%
Midterm	25%
Case Studies and Projects	25%

Final grades will be assigned as follows:

90 to 100	A- / A
80 to 90-	B- / B / B+
70 to 80-	C- / C / C+
60 to 70-	D / D+
< 60	F

ASSIGNMENTS

There will be an assigned reading before each class session. Each reading will be accompanied by a question sheet that must be completed based on materials. The question sheet must be turned in at the start of the next class period.

Late assignments will not be accepted.

Other assignments will be described on handouts or posted on the course website. Assignments are to be completed individually or as part of a group, as specified for each assignment. No violations of the honor code will be tolerated (i.e., your work must be your own).

QUIZZES

Quizzes will be handed out at the start of each class period and will be based on the reading assigned for that period or material covered in the previous class. No make-up quizzes will be given.

MIDTERM

One midterm exam will be given during the semester, as noted in the course schedule; any changes will be announced at least two weeks in advance. Specified reference materials may be used during specified parts of the exam. The exam may not be missed without prior approval or a proper medical excuse. Scheduling of a make-up exam must be coordinated with the instructor. Missing an exam without a valid excuse will result in a zero averaged into your grade.

CASE STUDIES AND PROJECTS

Projects and Case Studies will be assigned over the course of the semester. The purpose of these exercises is to provide students with opportunities to apply their knowledge and develop research, data-gathering and analysis skills. Details will be provided during the semester. As there is no final exam in this course, the projects and case studies will be weighted significantly in the final course grade.

FIELD TRIPS

Several field trips will be organized over the course of the semester. Attendance and participation on each field trip will count as a 100 pt reading assignment. These include a trip to the Sacramento SMUD Consumer Service Center and a tour of the Pacific student center construction site.

TABLET PCS

Each student will be assigned an HP Tablet PC for use during the class period for note-taking, accessing information, etc.

SERVICES FOR STUDENTS WITH DISABILITIES

If you are a person with a disability that requires accommodation, please see Mr. Daniel Nuss (dnuss@pacific.edu) in the Office of Services for Students with Disabilities in Bannister Hall Room 101 to obtain an Accommodation Request Form. Then please schedule a meeting with me during office hours to arrange the accommodation(s).

HONOR CODE

Each student is expected to uphold the accepted standards of good citizenship and the spirit of the Honor Code clearly stated in the Tiger Lore Student Handbook. A violation of the Pacific Honor Code may occur in one of the following areas:

1. Giving or receiving information from another student during an examination.

2. Using unauthorized sources for answers during an examination.
3. Illegally obtaining test questions before the test.
4. Plagiarizing - any and all forms on homeworks, papers, projects, etc. - this includes copying computer files.
5. Using another person's work as a "guide" for homework, lab reports, etc.
6. Giving someone else your work so they can copy it, submit it as their own, or use it as a guide is also in violation of the Honor Code!!

Honor Code violations will not be tolerated. Any work submitted that is in violation of the Pacific Honor Code will not be graded, will automatically receive a 'zero' grade, and must be completely redone and resubmitted. A student who is found to violate the Honor Code may receive an 'F' for the course, will be reported to the SOECS Dean of students and to the Pacific Office of Student Life, and may be considered for dismissal from the Engineering program.

LAST, BUT NOT LEAST

Cell phone ring/buzz = Home-made cookies provided to the class by the responsible party! (and by the person who called him/her, if it is another student in the class).

COURSE SCHEDULE

	Day	Topic / Lab
Week 1 1/14 - 1/18	M	Introduction, Definitions
	W	Sustainability and Engineering Design
Week 2 1/21 - 1/25	M	*Martin Luther King Holiday*
	W	Energy production and use
Week 3 1/28 – 2/1	M	Life Cycle Assessment -Introduction
	W	*Student Presentations – Sustainability applications*
Week 4 2/4 – 2/8	M	*Student Presentations – Sustainability applications*
	W	Life cycle assessment - EIO approach
Week 5 2/11 – 2/15	M	Life cycle assessment - EIO approach
	W	Life cycle assessment - case studies and software
Week 6 2/18 – 2/22	M	*Presidents' Day Holiday*
	W	Sustainability application - Land Development – Water
Week 7 2/25 – 2/29	M	Sustainability application – Transportation systems
	W	Sustainability application - Industrial sustainability
Week 8 3/3 – 3/7	M	High performance buildings, LEED
	W	Guest speaker - Bruce Boccei, Consol
3/10 - 3/14		SPRING BREAK
Week 9 3/17 – 3/21	M	Campus sustainability assessment
	W	Campus sustainability project
Week 10 3/24 – 3/28	M	*Travel Day - Holiday*
	W	Guest speaker – Scott Heaton, University Sustainability Initiatives
Week 11 3/31 – 4/4	M	Regulations and ethics – global and local scales
	W	Student Projects – Sustainable Design
Week 12 4/7 – 4/11	M	Guest speaker and field trip – Dr. David Fletcher – University Center construction site
	W	Midterm
Week 13 4/14 – 4/18	M	Sustainability application – Sustainability in the organization
	W	Sustainability application – Agriculture
Week 14 4/21 – 4/25	M	Student Projects
	W	Student Projects – Draft Sustainable design proposal due and peer reviews
Week 15 4/28 – 5/2	M	Field Trip – SMUD Customer Service center
	W	Wrap-up
Week 16 5/5	M	*Student Presentations – Sustainable Design*
Finals Week	M	*May 12, 7 – 10 p.m.; Student Presentations – Sustainable Design*

Note: Guest speaker and field trip dates are subject to change.

57. Sustainable Futures

Michigan Technological University

SUMMARY

Offered by: Engineering
Instructor(s): David Shonnard (Chem E), John Sutherland (ME), Mary Durfee (SS), Loinel Lyles (Policy, Southern University)

Number of times taught: Three or More
Class size: 10 to 30
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Graduate
Students' Major: 80% Engineering
20% Non engineering

ENG5510-4510 Sustainable Futures I:
Principles and Tools of Sustainability
Fall 2007

Professor David Shonnard
Chemical Engineering
Chem Sci 202 I
drshonna@mtu.edu
Office Hours: 2:00 – 3:00 pm Tue. & Thur.

Time: Tue., Thur., 3:05 – 4:20 pm

Location: room B45 Electrical & Energy Resources Center (EERC) (Bldg. 7)

WebPage: http://www.chem.mtu.edu/~drshonna/eng5510/F2007/index.html
Username: eng5510 Password: sf1f04

Teaching Assistant: Mohit Law (mslaw@mtu.edu or Law@mtu.edu)

Description:

Covers introductory to advanced concepts of Sustainable Development. Explores methods / tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging technologies. Provides advanced training in life cycle assessment (LCA) of technologies, processes and products, using state of the art software plus relevant applications through assignments and term project. Explores the use of LCA and other sustainability assessment tools in decision making in government and industry. Guest speakers provide real-world perspectives.

Readings:

No required textbook.
Daily/Weekly assigned readings on topics from course outline. Do the readings assigned for the day BEFORE coming to class.

Your Grade:

Grade is based on assigned LCA problems, writing assignments, exams, and a term project. Distribution of grade:

Assignments (30%), 2 exams (30%), Life Cycle Assessment project (30%), participation in classroom discussions (10%).

Explanation of Assignments:

Writing assignments based on readings, lectures and outside research. Case study analyses of sustainable industrial technologies using comparative life cycle assessment.

Academic Integrity Statement

All students must comply with university policy on academic integrity as found in the student handbook. If you have a question about permissible use of materials, collaboration with

students, etc. please ask. This is a complex topic due to new technologies and the widespread use of teamwork. We are happy to discuss it.

ADA Statement

MTU complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disability Act of 1990 (ADA). If you have a disability and need reasonable accommodation for equal access to education or services at MTU, please call Dr. Gloria Melton, Dean of Students. 487-2212. For other concerns about discrimination, you may contact your advisor, department chair, or the Affirmative Action office (487-3310). You might also just say something to either of us, so that we can address it ourselves.

Course Assignments

Do the readings assigned for the day BEFORE coming to class

Week 1: Introduction to Sustainable Development September 4 Introduction to Course (writing exercise for assessment purposes) 6 Global Indicators of Sustainability and Trends over Time – classroom discussions. **Reading**: Brundtland Commission Report "Development and International Economic Cooperation – Environment - Report of the World Commission on Environment and Development – From One Earth to One World: An Overview by the World Commission on Environment and Development", 1987, pages 18-38.
Week 2: Life Cycle Assessment (LCA) as a Tool to Evaluate for Sustainability 11 Goal / Scope Definition – Inventory Analysis 13 Allocation Methods, Impact Assessment, EcoIndicator 99 from SimaPro7.0 **Reading**: Chapter 13 in Allen and Shonnard, "Green Engineering: Environmentally Conscious Design of Chemical Processes", Prentice Hall, 2002.
Week 3: Life Cycle Assessment (LCA) Concepts and SimaPro7.0 18 SimaPro7.0 Demonstration and Workshop (room 204 CSEB-Student Computer Lab): Introduction to SimaPro7.0 LCA software **Assignment:** Homework #1. Abbreviated LCA of light bulbs. 20 SimaPro7.0 Demonstration and Workshop (room 204 CSEB-Student Computer Lab): Light Bulb Comparison
Week 4: Advanced Life Cycle Assessment Concepts 25 Options for allocation of inventory elements for multi-product processes - biodiesel example 27 **Reading**: Bernesson, S. et al., "A limited LCA comparing large- and small-scale production of rape methyl ester (RME) under Swedish conditions", (2004), *Int. J. LCA*, **25**, 454-559.
Week 5: Advanced Life Cycle Assessment Concepts – Impact Assessment October 2 Life Cycle Impact Assessment **Reading**: ISO 14042, International Organization for Standardization, Sections 5-9.

	Reading: Bare, J. et al. "**TRACI**-The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts" (2003), Journal of Industrial Ecology, 6(3-4), pages 49-55. **Reading**: Goedkoop, M. et al. "Introduction to Life Cycle Assessment using SimaPro7.0" (2006), Chapter 4. **Reading**: Goedkoop, M. and Spreinsma, R. "The Eco-Indicator 99: A damage oriented method for Life Cycle Impact Assessment-Methodology Report", Chapter 7.
4	Life Cycle Impact Assessment-Overview of the Eco-Indicator 99 Methodology **Reading**: Goedkoop, M. and Spreinsma, R. "The Eco-Indicator 99: A damage oriented method for Life Cycle Impact Assessment-Methodology Report", Chapter 2.
Week 6: Advanced Life Cycle Assessment Concepts – Impact Assessment (cont.)	
9	Life Cycle Impact Assessment-Overview of the Eco-Indicator 99 Methodology
11	SimaPro7.0 Workshop (room 204 CSEB-Student Computer Lab): Hand Dryer Assignment
Week 7: Advanced Topics in Sustainability: Global Energy Issues	
16	Assignment of Term LCA Project **Reading**: "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies", S. Pacala and R. Socolow, *Science*, 305, 968-972, 2004. **Assignment:** Homework #3. CMI Stabilization Wedges Game
18	**Reading**: "Energy for Sustainable Development: A Policy Agenda", T.B. Johansson and J. Goldemberg, United Nations Development Programme, pages 1-38, 2002.
Week 8: Advanced Life Cycle Assessment Concepts – Societal Impacts and Economics	
23	Life Cycle Assessment: Societal Impacts **Reading**: "Socio-Eco-Efficiency Analysis: The Method", Kolsch et al., BASF, 2007.
25	Ecological Economics – Dr. Barry Solomon, Social Sciences, MTU. **Reading**: Daly, H. and Farley, Ecological Economics, Chapter 2. 2005.
Week 9: Advanced Topics in Sustainability: Population Problem, Industrial Sustainability	
30	Population Problem and Sustainability **Reading**: Hardin, G. "The Tragedy of the Commons", *Science*, 162, 1243-1248.
November	
1	Mining Industry Sustainability
Week 10: Shonnard to AIChE Meeting, Salt Lake City	
6	lecture cancelled
8	Lecture cancelled and take home examination due
Week 11: Advanced Topics in Sustainability: Chemical Industry and Forest Products	
13	Chemical Industry Sustainability **Reading**: "Sustainability of the Chemical Industry", Forum for the Future and UK Dept. of Trade and Industry, 2001.

15 Forest Sustainability Issues – Maria Janowiak, MTU's Northern Institute of Applied Carbon Science **Lecture**: Sustainability in Forest Management
Week 12: LCA Project Computer Lab Workshops 27 29
Week 13: Presentations of Student LCA Projects December 4 6
Week 14: More LCA Presentations and Course Evaluation 11 13

LCA Projects due middle of Finals Week.

58. Sustainable Manufacturing

University of California, Berkeley

SUMMARY

Offered by: Mechanical Engineering
Instructor(s): David Dornfeld

Number of times taught: Once
Class size: 30 to 100
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Graduate
Students' Major: information not provided

Sustainable Manufacturing

TuTh 11:00AM-12:30PM, 3107 Etcheverry Hall

Instructor: D. Dornfeld (dornfeld@berkeley.edu)
www.me.berkeley.edu/e290c/s08/lec001 and "b-space"

Course Description: Sustainable manufacturing is a poorly understood idea and one that is not intuitively connected to business value or engineering practice. This course will provide the basis for understanding (1) what is envisioned as sustainable manufacturing and how that relates to larger issues of global warming, energy independence, and social impact, (2) what comprises sustainable manufacturing practices in for-profit enterprises, (3) how to practice and measure continuous improvement using sustainability thinking, (4) techniques and tools for product and manufacturing process design and development, and (5) effective communication of sustainability performance to internal and external audiences. The primary focus of this course is manufacturing processes, systems and tooling/machinery including energy, materials, consumable and supply chain and distribution elements as they impact manufacturing.

Material in the course will be supplemented by speakers with diverse backgrounds in corporate sustainability, environmental consulting, and academia. Discussions of papers/references in a reader including case studies will be used to illustrate topics. A final class project will be required, with students working individually or in small groups in partnership with industrial contacts. Cross functional groups comprised of students from different academic backgrounds will be encouraged. Class projects will apply the analysis techniques covered in this course to design and develop environmentally mindful products or processes or analyze policies that lead to environmental improvements. Interaction with industry and collection of real-world data will be encouraged.

Requirements: Graduate standing or consent of instructor; useful background: ME 290E: Green Product Development, Design for Sustainability; ME220 Precision Manufacturing; ME221 Rapid Prototyping; and ME101 High Mix/Low Volume Manufacturing.

(Part of course offerings for Management of Technology (MOT) and Engineering and Business for Sustainability (EBS) program in the College of Engineering.)

Instructor: David Dornfeld is in the Mechanical Engineering Department and is the Will C. Hall Family Professor of Engineering; He is Director of the Laboratory for Manufacturing and Sustainability at Berkeley, lmas.berkeley.edu.

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Syllabus/Course Outline

Week	Date	Topic
1	(1/22, 1/24)	Course introduction; overview, background and drivers for sustainable business and manufacturing; corporate sustainability; life cycle issues. (Can we define "sustainable" manufacturing?) *Reading*: Greening Chap 1 & 2; Natural Preface & Chap 1*
2	(1/29, 1/31)	Developing metrics for sustainable business practices, design and manufacturing; regulatory (US and global) considerations. *Reading*: Greening Chap 3; Natural Chap 2
3	(2/5, 2/07)	Review of manufacturing tools, processes and systems (including the distribution and supply chain). *Reading*: Greening Chap 4; Natural Chap 3, 4, 6 & 7 Project team composition/project introduction.
4	(2/12, 2/14)	Analytical tools for sustainability assessment; life cycle assessment/impact (LCA/I) tools. (What is "green" manufacturing?) *Reading:* Green Chap 5, 6 & 7; Natural Chap 8 & 9
5	(2/19, 2/21)	Case study in manufacturing analysis for sustainability: i. Nanoscale manufacturing and ii. Process technologies for alternative energy. *Reading:* Greening Chap 8 & 9, 26
6	(2/26, 2/28)	Case study in manufacturing analysis for sustainability: iii. Solar panel manufacturing, iv. Semiconductor manufacturing. *Reading:* Greening Chap 11, 12 & 19
7	(3/4, 3/08)	Case study in manufacturing analysis for sustainability: v. Automotive manufacturing, vi. "Conventional" manufacturing. *Reading:* Greening Chap 17, 18 & 21
8	(3/11, 3/13)	Outside speaker 1Sustainability Thinking and Implementation in Business; Outside speaker 2: NGO/Deriving Business Value out of Sustainability Initiatives; Natural Chap 13
9	(3/18, 3/20)	Strategies for design, operation and control of sustainable manufacturing tools, processes and systems. *Reading:* Otto, *Product Design*, Chap 15 (reader) and Poole, *Green Design* (reader)
10	(3/25, 3/27)	**Spring Break**
11	(4/1, 4/03)	Design, operation and control of sustainable manufacturing tools, processes and systems, cont'd. (Materials selection, etc.)
12	(4/8, 4/10)	Green factories; Outside speaker 3: Green Design and Manufacturing in Consumer Products; *Reading:* Greening Chap 23, 24 & 25
13	(4/15, 4/17)	Outside speaker 4: Business strategy for sustainability; Product Stewardship in Industry; Sustainability communication and public reporting.

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		Reading: Natural Chap 14 & 15
14	(4/22, 4/24)	Business models for sustainable manufacturing. *Reading:* Natural Chap 8; Greening Chap 27 and 28
15	(4/29, 5/1)	Student project/paper presentations
16	(5/6, 5/08)	Course wrap-up; report preparation.

* **Greening** = Graedel and Howard-Grenville, *Greening the Industrial Facility*, 2005 and **Natural** = Hawken *et al, Natural Capitalism: Creating the Next Industrial Revolution*, 1999 (See course textbooks)

Instructor

Professor David Dornfeld
Department of Mechanical Engineering
5100A Etcheverry Hall
642-0906; dornfeld@berkeley.edu

Office Hours: Tu 1-2, W 11-12 or by appointment

Text

Recommended textbooks:

- T. E. Graedel and J. A. Howard-Grenville, *Greening the Industrial Facility*, Springer, 2005 (Amazon)
- Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, Little, Brown and Company, Boston, 1999 (Amazon)

A course notes/reader will also be used.

Web Site: http://www.me.berkeley.edu/e290c/s08/lec001/ and b-space;

NOTE: **B-space is the primary source of information for this class!**

Course Project

One major course project (group) will be required related to the course content and focus. Possible projects could be on one of the following general topic areas (NOT an exhaustive list!):

- metrics for assessing sustainable processes or systems
- sensors for energy/material/consumable/resource monitoring
- sustainable machine operation budget determination
- strategies for optimizing the energy/sustainable performance of production systems
- environmentally/sustainable machines/machine tool design
- process planning
- process modeling
- software for design and analysis of sustainable systems and processes

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- "Cleantech" applied to production systems (from resource extraction to recycling)
- Web-based assessment/design tools
- CAD based assessment/design tools
- re-manufacturing
- business strategies for environmentally benign/sustainable manufacturing
- design "rules of thumb"
- material selection strategies
- LCA tools linked to process/system details
- Case studies of successful (or unsuccessful) attempts at green/sustainable processes/systems
- Tools/strategies for evaluation of social and natural resource impact
- Web-based resource tools for information on sustainable manufacturing
- Instrumentation for measuring/monitoring/assessing process/system/device performance

Other project topics may be chosen in consultation with the Instructor and may be ones associated with another graduate class you are enrolled in or your graduate studies. For example, students enrolled in another course may be interested in combining projects. A final project presentation and report is required. Special preference is given to projects which utilize or link to commercial CAD packages (AutoCAD or Solidworks, for example) for definition of machine/process behavior, spread sheet-driven simulations (or other software such as Labview) of errors, costs, process models, etc. or other computer/network-based software simulations including Java-based applets. Novel format (Video, You-tube format) presentations are also encouraged. You and your team may also develop "instructional" simulations or experiments for future E290C classes.

Homework, Exams and Grading

Homework will be assigned and due the following week unless otherwise indicated.

There is no mid-term exam. The final exam is a take home exam/paper.

The grade will be determined on the following basis:

Homework	25%
Project	45%
Final	30%

(exceptional class participation + 5-10%)

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Additional Reading List and Sources of Information (not exhaustive!)

Reference Literature (some are on reserve in Eng'g Library; some are in the reader to be provided)

[Allenby, 1994] Braden R. Allenby and Deanna J. Richards, eds., *The Greening of Industrial Ecosystems*, National Academy Press, Washington, DC, 1994. ISBN 0-309-04937-7

[AME, 2008] –, *Green Manufacturing: Case Studies in Leadership and Improvement*, Association for Manufacturing Excellence (AME), 2008. ISBN 978-1-56327-389-6

[Birkland, 2002] Birkland, Janis, *Design for Sustainability*, Earthscan, London, 2002. ISBN 978-1-85383-897-2

[Esty, 2006] Daniel C. Esty and Andrew S. Winston, *Green to Gold*, Yale University Press, New Haven, 2006. ISBN 0-300-11997-6

[Graedel, 2005] Thomas E. Graedel and Jennifer A. Howard-Grenville, *Greening the Industrial Facility: Perspectives, Approaches and Tools*, Springer, 2005. ISBN 0-387-24306-2

[Hawken, 1993] Paul Hawken, *The Ecology of Commerce: A Declaration of Sustainability*, Collins, 1993. ISBN 0-88730-655-1

[Hawken, 1999] Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, Little, Brown and Company, Boston, 1999. ISBN 0-316-35316-7

[Hendrickson, 2006] Chris T. Hendrickson, Lester B. Lave and H. Scott Matthews, *Environmental Life Cycle Analysis of Goods and Services: An Input-Output Approach*, Resources for the Future, Washington DC, 2006. ISBN 1-933115-24-6

[McDonough, 2002] William McDonough and Michael Braungart, *Cradle to Cradle*, North Point Press, 2002. ISBN 0-86547-587-3

[Otto, 2001]Kevin Otto and Kristin Wood, *Product Design*, Prentice-Hall, Upper Saddle River, NJ., 2001. ISBN 0-13-021271-7 (Chapter 15 Design for the Environment pp. 719-779) and http://cwx.prenhall.com/cgi-bin/binder/syl.cgi?site=otto_wood.

[Poole, 2007] Buzz Poole, ed., *Green Design*, Mark Batty, New York, NY, 2007. ISBN 0-9762245-8-5

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[Seliger, 2004] Gunther Seliger, Nabil Nasr, Bert Bras and Leo Alting, eds., Proceeding Global Conference on Sustainable Product Development and Life Cycle Engineering, Uni-Edition, Berlin, 2004. ISBN 3-937151-21-4

[Tester, 2005] Jefferson Tester, Elisabeth Drake, Michael Driscoll, Michael Golay and William Peters, *Sustainable Energy: Choosing Among Options*, MIT Press, Cambridge, MA, 2005. ISBN 0-262-20153-4

Other Links of interest:

- Wuppertal Institute: http://www.wupperinst.org/FactorFour/FactorFour_links.html
- Japan for Sustainability: http://www.japanfs.org/; specially publications such as industry sustainability reports: http://www.japanfs.org/en/business/reports_cat_13.html
- Rocky Mountain Institute http://www.rmi.org/sitepages/pid23.php
- Greenblue: http://www.greenblue.org/
- Energy Information Agency (US Gov't) http://www.eia.doe.gov/

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Topic
Environmental issues with industry 1. Allen D. T, Shonnard D. R., Green Engineering, Environmentally Conscious Design of Chemical Processes. An Introduction to Environmental Issues, Chapter 1, pp. 3-30 2. UNEP, Global environmental outlook, 2000, Overview, http://www.unep.org/geo2000/ov-e/index.htm, 2006 annual report http://www.unep.org/publications/search/pub_details_s.asp?ID=3919
Risk, Health impacts, Environmental Justice 1. Slovic P., "Trust, emotion, sex, politics, and science: surveying the risk assessment battlefield," Risk Analysis 19 (4), p.. 689-700, http://www.kluweronline.com/article.asp?PIPS=220830 2. Auberson-Huang L., "The dialogue between precaution and risk," Nature, Vol. 20 (11), 2002, pp. 1076-1078, http://www.nature.com/cgi-taf/DynaPage.taf?file=/nbt/journal/v20/n11/full/nbt1102-1076.html 3. World Health Organization, The world health report 2002, Overview and Chapter 4, Page 10, http://www.who.int/whr/2002/en/; and The world health report 2007 - A safer future: global public health security in the 21st century, http://www.who.int/whr/2007/en/index.html
Regulations 1. "Environmental Law: Exploring the Influence on Engineering Design," http://css.snre.umich.edu/makeframe.php?content=css_edu_resources
Design for Environment (DFE) and Green Manufacturing 1. Green Products by Design: Choices for a Cleaner Environment, September 1992, OTA-E-541, policy.rutgers.edu/andrews/courses/9221.pdf, Summary (Chapter 1) and Chapter 2: Materials and design. 2. Fitzgerald, D. et al, Beyond Tools: A Design for Environment Process, Int. J. of Performance Engineering, 1, 2, Oct 2005, pp. 105-120. http://scholar.google.com/scholar?q=1.%09+%E2%80%9CEnvironmental+Law:+Exploring+the+Influence+on+Engineering+Design,%E2%80%9D+&hl=en&client=firefox-a&rls=org.mozilla:en-US:official&hs=kLJ&um=1&ie=UTF-8&oi=scholart
Design for Environment 1. Green Products by Design: Choices for a Cleaner Environment, September 1992, OTA-E-541, policy.rutgers.edu/andrews/courses/9221.pdf, Chapter 3 (DFX) 2. Fiskel J., Chapter 8: Practical DFE guidelines, From: Design for environment: Creating eco-efficient products and processes, McGraw Hill, 1996, pp. 91-111. 3. Allenby B., The conceptual framework of DFE at AT&T, From: Design for environment: Creating eco-efficient products and processes, Fiskel J., ed., McGraw Hill, 1996, pp. 155-177
Life Cycle Assessment (LCA) 1. Green Products by Design: Choices for a Cleaner Environment, September 1992, OTA-E-541, policy.rutgers.edu/andrews/courses/9221.pdf, Chapter 4, Strategies for Green Design 2. McDonald's case study, the clamshell controversy http://www.umich.edu/~nppcpub/resources/compendia/ind.ecol.html
Alternative LCA techniques 1. Hendrickson C., Horvath A., Joshi S., Lave L., "ECONOMIC INPUT-OUTPUT MODELS FOR ENVIRONMENTAL LIFE-CYCLE ASSESSMENT," Environmental Science & Technology. 32(7):A 184-A 191, 1998 Apr 1. 2. Designing the perfect green product: SLCA in reverse Graedel, T.E.; Electronics and the Environment, 1997. ISEE-1997., Proceedings of the 1997 IEEE International Symposium on , 5-7 May 1997 Page(s): 317 –321.
Green Manufacturing Primer 1. Assessment of Environmentally Benign Manufacturing (EBM) Technologies, http://www.wtec.org/loyola/ebm/, Executive summary, Chapter 1.

January 14, 2008

Green Manufacturing

1. Assessment of Environmentally Benign Manufacturing (EBM) Technologies, http://www.wtec.org/loyola/ebm/, Chapter 5: Materials and Products (Metals, polymers)
2. Dornfeld, D. and Wright, P., "Technology Wedges for Implementing Green Manufacturing," Trans. North American Manufacturing Research Institute, 2007, vol. 35, pp. 193-200.

January 14, 2008

59. Sustainable Products, Processes and Systems

University of Kentucky

SUMMARY

Offered by: Mechanical Engineering
Instructor(s): I.S. Jawahir

Number of times taught: Three or More
Class size: 10 to 30
Class format: 2 hours of lecture plus 1 hour of discussion per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Graduate
Students' Major: ≥90% Mechanical Engineering

University of Kentucky
ME 699/MFS 699 Sustainable Products, Processes and Systems
Fall 2007

Course Outline

Module 1: An Introduction to Sustainability
(2 Weeks: L1 and L2)

- Definitions
- Societal, Environmental and Economic Sustainability – The Traditional Approach
- General Sustainability Applications
- New Trends in Sustainability Concept Development for Manufacture: Products, Processes and Systems

Module 2: Life-cycle Products: Design and Manufacture
(2 Weeks: L3 and L4)

- Traditional LCA methods
- Theory and Applications for LCA
- Products Design and Manufacture for Sustainability
- Multi Life-cycle Products and Perpetual Products
- Case Studies in Automotive, Aerospace and Consumer Products Manufacturing **(Assignment 1)**

Module 3: Sustainable Products
(3 Weeks: L5, L6 and L7)

- Product Requirements
- Elements of Product Sustainability: Product Design for Sustainability
  - (a) Product's Resource Utilization and Economy (materials use, energy efficiency, etc).
  - (b) Product's Environmental Impact (life-cycle, ecology, etc.)
  - (c) Product's Societal Impact (safety, personal health, ethics, etc.)
  - (d) Product's Functionality (service life, modularity, maintainability, upgradeability, ergonomics, etc.)
  - (e) Product's Manufacturability (manufacturing methods, assembly, packaging, transportation, etc.)
  - (f) Product's Recyclability/Remanufacturability (disassembly, componen separation, reusability, etc.)
- Sustainability Assessment in Manufactured Products
- End-of-life Products and Product Take-back Options
- Case Studies: (a) Automotive Products
  (b) Aerospace Products
  (c) Consumer Electronics Products
  (d) Domestic Appliances
- Present Trends **(Assignment 2)**

Module 4: Sustainability Applications in Manufacturing Processes
(2 Weeks: L8 and L9)

- Elements of Sustainability in Manufacturing Processes
- Assessment of Sustainability in Manufacturing Processes
- Case Studies:
  - (a) Machining Processes
  - (b) Forming Processes
  - (c) Materials Joining Processes
  - (d) Injection Molding Processes
  - (e) Non-traditional Manufacturing Processes

Module 5: Sustainable Systems for Manufacturing
(1 Week: L10)

- Sustainability Applications in Manufacturing Systems
- Case Studies **(Assignment 3)**

Module 6: Project Work
(3 Weeks: P1, P2 and P3)

- Identification of an industry project
- Sustainability evaluation of a given product/process
- Sustainability improvement study
- Technical documentation
- Technical presentation

(Project Report)

Notes: Ten lectures (L1 - L10) and three project classes (P1 – P3) will be held on Monday in FPAT 253 at 1.00 – 1.50 p.m.

Wednesday classes are sustainability seminars held in RMB 309 at 1.00 – 1.50 p.m

Textbook

None (Course lecture material will be provided)

Reference Material

Website links and all relevant references will be provided

Course Evaluation

Assignment 1: State-of-the-Art Review (Due in Week 3)	15%
Assignment 2: Product Sustainability Evaluation (Due in Week 6)	20%
Assignment 3: Process Sustainability Evaluation (Due in Week 9)	20%
Project: Industry-sponsored Project (Due in Week 13)	30%
Technical Presentation	15%

60. Sustainable Water Resources

Santa Clara University

SUMMARY

Offered by: Civil Engineering
Instructor(s): E. Maurer

Number of times taught: Once
Class size: Less than 10
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Upper division and graduate (4:1)
Students' Major: ≥90% Civil Engineering

CENG 161/261 – Sustainable Water Resources: concepts and methods

Spring 2008

Instructor: Ed Maurer emaurer@engr.scu.edu

Class Meeting Time and Office Hours:

MWF, 9:15-10:20 am, EC 304
Tues, Thurs 3:45-4:30 pm, or email me to set up other office hours by appointment.

Official Class Web Site:

http://www.engr.scu.edu/~emaurer/classes/ceng161_sustainability/
Note that this web site contains the official class syllabus, schedule, homework assignments, handouts, etc. This will be updated regularly (superseding this handout), with announcements made in class for new assignments or other significant changes.

Recommended Texts (none required):

1. *Water Resources Sustainability*, Mays, L.W., 2007. McGraw-Hill, New York.
2. *Water in Crisis: A Guide to the World's Fresh Water Resources*, 1993, Gleick, P.H. (ed.), Oxford University Press, New York.
3. *Water Resources Systems Planning and Management* , Loucks, D.P. and E. van Beek, 2005, UNESCO Publishing, Paris.

One copy of the first and second text are on reserve at the SCU Library for this quarter.

Course Description:

Catalog Description: Analysis and design of water resource systems, from flood control projects to drinking water supply, as environmental constraints and societal values shift includes sustainable and low impact design techniques, climate change impacts on water, assessing sustainability, life-cycle economics, current topics.

Overview: This course will review sustainability and sustainable development in the context of water resources. The focus will be on many scales, from water conservation technologies to regional water resources impacts of climate change. Topics will include definitions and concepts of sustainability, techniques for economic analysis, simulation, and operation of water resources systems, and how these may be applied in engineering to assess water sustainability.

Course Goals and Learning Outcomes:

Students completing this course will be able to:

- Statistically manipulate hydrologic data sets to examine long term changes and trends to place hydrologic design in a historical context.
- Understand the concept of statistical stationarity, and how the assumption is built into engineering design.
- Understand the impact of human-induced climate disruption on water resources, and engineering design implications of the projected changes.
- Apply life-cycle analysis to a water project
- Incorporate sustainable standards like LEED into the water aspects of an engineering planning project
- Incorporate low-impact technologies for flood control and water management into urban stormwater management design.
- Apply optimization analysis to a simple water resources system.
- Students will expand their understanding of hydrology and water resources from earlier courses to be able to apply newly emerging techniques to hydrology and hydraulic design.
- Communicate how sustainability is reflected in a current water issue through a class project, both orally and in written form.

Prerequisites:
Junior or Senior standing. Prerequisite: CENG 140 (may be taken concurrently) or permission of instructor. Basic computer familiarity (with Microsoft Windows operating system, Windows Explorer, Excel and Word). An understanding of the hydrologic cycle and some skills with basic hydrologic statistical analysis such as developing probability distributions from a data set.

Assessment and other class policies:

This class places a heavy emphasis on readings and class participation for discussions. The grading structure may be adjusted during the first half of the course:

Homeworks and class participation:	30%
Class Projects/Exercises	50%
Final Project	30%

CENG 161 **Sustainable Water Resources** **Elective Course**

3 quarter units

March 4, 2008
Dr Edwin P. Maurer

Course-based Student Outcomes:

Program Outcome Addressed	Relevant Educational Concept(s)	Specific Student Learning Outcome(s) After completing this course, students will be able to:
2	Students will gain knowledge in five specialty areas of civil engineering and be able to identify and analyze problems and design basic elements or related systems.	Statistically manipulate hydrologic data sets to examine long term changes and trends to place hydrologic design in a historical context. Apply life-cycle analysis to a water project
5a	Students will understand contemporary issues at the local and global level.	Understand the concept of statistical stationarity, and how the assumption is built into engineering design. Incorporate sustainable standards like LEED into the water aspects of an engineering planning project
5b	Students will understand the responsibility of civil engineering in a global and societal context.	Understand the impact of human-induced climate disruption on water resources, and engineering design implications of the projected changes.
5d	Students will understand the value of life-long learning.	Students will expand their understanding of hydrology and water resources from earlier courses to be able to apply newly emerging techniques to hydrology and hydraulic design.
6	Students will be able to communicate effectively in written and oral forms as part of individual assignments and team-based activities.	Communicate how sustainability is reflected in a current water issue through a class project, both orally and in written form.

61. Systems Perspectives on Industrial Ecology

Massachusetts Institute of Technology

SUMMARY

Offered by: Engineering Systems Division
Instructor(s): Frank Field and Randy Kirchain

Number of times taught: Three or More
Class size: 10 to 30
Class format: 3 hours of lecture plus 3 hours of "other" contact per week

Portion of course focused on sustainable engineering: Less than 10%, 10 to 25%, 25 to 50%, More than 50%

Student Level: Graduate and upper division (9:1)
Students' Major: 35% Engineering Systems
45%Other Engineering
20% Non-engineering

ESD.123J / 1.814J / 3.560J Systems Perspectives on Industrial Ecology

Spring 2006

Syllabus

Overview

Engineers can fundamentally change the environmental footprint of modernity. To effect change, engineers require tools to identify "better" design and operational options. This course examines the use of life-cycle thinking and assessment tools to identify product and system design options that balance environmental and economic performance.

Prerequisites

ESD.10 or 3.56.

Readings

Because the course covers a broad range of topics, there is no textbook. Students will be expected to consult the assigned readings, lecture notes, and other handouts.

Coursework

Students are expected complete the homework assignments. Additionally, students will work in teams on two unit projects, producing a case study report and in-class presentation for each.

Grading

Grades will be based on various assignments throughout the term. Their approximate weights are:

ACTIVITIES	PERCENTAGES
Assignments	35%
Case 1 Presentation / Report	20%
Case 2 Presentation / Report	30%
Class Participation	15%

The final grade will be modulated by an appreciation of the participant's progress throughout the semester, giving extra weight to those that finish strongly and demonstrate that they have mastered the material, in the end.

Course Policies

Absences

Students are expected to complete all assignments on time. Unexcused late assignments will be marked down. Reasonable excuses (sickness, unavoidable professional absences, family emergencies, etc.) will of course be accepted when presented near the event.

Work in Teams

Students will likely work in teams for the unit projects. Indeed, we encourage this collaboration because it can lead to more interesting results. We require each student to turn in individually written interpretations of the common analysis.

Academic Honesty

To avoid any potential confusion that might result from different expectations in other courses or establishments, please note the standards that apply in this subject:

- Anyone found cheating during the in-class exam will receive a zero for the exercise.
- Assignments turned in for grading are to be done individually, although it is expected that students will discuss the issues involved in problem sets and often learn best collectively. In practice this means that students may lead each other to the proper understanding of the material, and collaborate on setting up computer runs, but should ultimately prepare reports for each assignment individually, in their own format and words. Demonstrated evidence of copying (exactly the same presentations, same wording of sentences, etc.) will result in zeros for each paper with this evidence.

Class Schedule

LEC #	TOPICS	KEY DATES
1	Introduction	
Part 1: Views on Industrial Ecology		
2	What is Industrial Ecology?	Assignment 1 due
3	Environmental Paradigm	Assignment 2 due
4	Sustainability: Concepts and Metrics	
5	Resource Economics	
6	Resource Economics (cont.)	
7	Resource Econ Group Presentations	Assignment 3 due
Part 2: LCA: Method Basics		
8	Life-cycle Assessment - Overview	
9	Using the Software	

LEC #	TOPICS	KEY DATES
10	LCA - Scope	
11	LCA - Inventory	
12	LCA - Inventory Allocation	Assignment 4 due
13	LCA - Recycling	
14	Materials Flow Analysis	
Part 3: Environmental Evaluation and Advanced Methods		
15	Overview of Case 2	
16	LCA - Impact Assessment - EPS	
17	LCA - Impact Assessment - EcoPoints	
18	LCA Research	
19	Case 1 Presentations	
Part 4: Aggregate Materials Flows		
20	National Materials Flows	
21	Material Flow Case Study	
Part 5: Environmental Policy Strategies		
22	Environmental Policy Making (Part 1)	
23	Environmental Policy Making (Part 2)	
24	Industrial Ecology Research @ MIT	
25	Final Presentations	

62. Traffic Operations

University of Virginia

SUMMARY

Offered by: Civil and Environmental Engineering
Instructor(s): Brian Park

Number of times taught: Three or More
Class size: 10 to 30
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: Less than 10%

Student Level: Upper division
Students' Major: ≥90% Civil and Environmental Engineering

University of Virginia
School of Engineering and Applied Science
Department of Civil & Environmental Engineering
FALL 2007

CE 444 Traffic Operations

Monday and Wednesday, 2:00 – 3:15 PM, Thornton Hall D-221

Instructor:
Dr. Byungkyu "Brian" Park

Office:
Thornton Hall D-205
Phone: 434-924-6347
Email: bpark@virginia.edu

Office Hours:
Monday and Wednesday 1 – 2 PM or other time by appointment

Course Objectives:
The purpose of this course is to provide students with the knowledge of traffic operations including traffic data collection, safety and accident studies, traffic flow theory, highway capacity analysis, signalized intersection design and analysis, and sustainable transportation system. At the end of this course, the student should be able to understand basic traffic flow theory, to conduct traffic data collection and analysis, and to apply capacity analysis methods for both highway and signalized intersections.

Required Textbook:
- Nicholas J. Garber and Lester A. Hoel, Traffic and Highway Engineering, 3rd edition, Brooks/Cole Publishing Company, 2002.

Reference Textbooks:
- Roger P. Roess, Elena S. Prassas, and William R. McShane, Traffic Engineering, 3rd Edition, Prentice Hall, 2004.
- Jon D. Fricker and Robert K. Whitford, Fundamentals of Transportation Engineering: A Multimodal Systems Approach, Prentice Hall, 2004.

Additional References:
- TRB SR 209, Highway Capacity Manual. TRB, 2000.
- ITE, Traffic Engineering Handbook, 5th, Prentice Hall, 1999.
- ITE, Manual of Transportation Engineering Studies, 1994.

Late Assignment:

Each assignment will be due at the beginning of the class time as noted. Late assignment **will not** be accepted. However, the lowest score of the homework assignments will be dropped.

Video Podcast:
A group of students, depending on the size of the class but likely three to four students per group, should pick a topic in the area of sustainable engineering that are related to traffic operations or general transportation, and develop a Video Podcast with a length shorter than 7 minutes. A few examples will be shown in the class.

Term Project:
A group project will be assigned to two to four individuals depending on the class size. Detail information will be given during the semester. Interim report and presentation will be required. Final report will be due at the beginning of the last class and the project presentation will be made on the same day.

Grading:
The overall course average will be determined as follows:

Class participation	5%
Assignments	15%
Two Mid-Term Exams	20%
Project (Video Podcast)	15%
Term Project	20%
Final Exam	25%

Note: If you miss more than four classes, your grade will be at most B+.

Blog & Toolkit Homepages:
http://toolkit.virginia.edu/CE444-1
http://people.virginia.edu/~bp6v/ce444/

Course Outline:

Topic	Reading Assignment	Weeks	Note
Introduction	[G&H] Ch. 1 & 2	½	
Sustainable Transportation System	[F&W] Ch. 12	1	
Vehicle and Driver Characteristics	[G&H] Ch. 3 [RP&M] Ch. 2	1	
Probability and Statistics for Traffic Engineering	[RP&M] Ch. 7	1	
Traffic Data – speed, volume, travel time & delay, and parking	[G&H] Ch. 4 [RP&M] Ch. 8 & 9	1½	Video Podcast Topic Due; Exam 1
Safety and Accident Studies	[G&H] Ch. 5 [RP&M] Ch. 9	1	Term Project Assigned
Traffic Flow Theory	[G&H] Ch. 6	1½	
Intersection Design and Control	[G&H] Ch. 7 & 8 [RP&M] Ch. 3 & 4	1½	Exam 2
Signalized Intersections	[G&H] Ch. 10 [RP&M] Ch. 16-18 [HCM] Ch. 16	3	Term Paper Due
Highway Capacity and Level of Service	[G&H] Ch. 9 [HCM] Ch. 20-24	2½	Term Project Interim Presentation
Final Presentations & Final Exam		1	

Note: the schedule is subject to change.

63. Understanding Risk from a Sustainability Standpoint

Rochester Institute of Technology

SUMMARY

Offered by: Golisano Institute for Sustainability
Instructor(s): information not provided

Number of times taught: not yet taught
Class size: not yet taught
Class format: not yet taught

Portion of course focused on sustainable engineering: More than 50%

Student Level: not yet taught
Students' Major: not yet taught

Rochester Institute of Technology
Rochester, New York

GOLISANO INSTITUTE FOR SUSTAINABILITY

NEW COURSE PRPOSAL
Understanding Risk from a Sustainability Standpoint (5001-XXX)

1.0 **Title**: Understanding Risk from a Sustainability Standpoint **Date**: Oct. 3, 2007
Credit Hours: 4
Prerequisite(s): none
Corequisite(s): none
Course proposed by: Dr. Thomas P. Seager

2.0 **Course information:**

	Contact hours	Maximum students/section
Classroom	4	30
Lab	0	NA
Studio	0	NA
Other (specify _____)	0	NA

Quarter(s) offered (check)
__X__ **Fall** _____ **Winter** _____ **Spring** _____ **Summer**

Students required to take this course: (by program and year, as appropriate)
This is a required core course in the proposed Sustainability Ph.D. and M.S. programs.

Students who might elect to take the course:
Students who are interested in sustainability and the environmental aspects of manufacturing, production, consumption and other industrial activities. Several different types of students are expected to enroll, including

- Graduate students and exceptional undergraduate students throughout RIT seeking electives in sustainability or preparing to participate in research related to sustainability; and
- Qualified employees of area manufacturing, engineering, or environmental services firms, as well as government employees, seeking additional education related to sustainability and environmental management, engineering and/or design.

3.0 **Goals of the course (including rationale for the course, when appropriate):**
This course will enhance students' understanding of risk assessment, management and communication (in toto, *risk analysis*) as they relate to the three pillars of sustainability: economy, environment and society. Students who successfully complete this course will:

For Curriculum Committee Review Only

- Understand the fundamentals of economic finance, such as net-present and cost-benefit analysis, utility theory, option theory and strategies for financial decision-making;
- Understand the fundamentals of toxicological risk assessment, such as dose-response relationships and non-lethal toxic endpoints;
- Understand basic socio-political dimensions of risk, including risk perception and communication, environmental justice and market-based approaches to sustainability activism;
- Identify strategies for identifying, mitigating and managing sustainability risks; and
- Be prepared for further study in sustainable design, decision-making and policy.

4.0 Course description (as it will appear in the RIT Catalog, including pre- and co-requisites, quarters offered)

5001-XXX Understanding Risk from a Sustainability Standpoint
This course examines the three pillars of sustainability (economy, environment, society) from a risk analytic perspective and presents an introduction to financial, toxicological and socio-political risk assessment, management and communication. Topics include utility theory, net present value analysis, benefit-cost analysis, ecotoxicology, environmental impact statements, environmental justice, risk management and risk communication. Illustrative examples from contract management, financial markets, environmental history and supply chain management are discussed. This course prepares students for further study in sustainable design, decision-making and policy. It is a core course within the Sustainability M.S. and Ph.D. programs. (Enrollment in the Sustainable Production Systems program or permission of instructor) Class 4, Credit 4 (F)

5.0 Possible resources (texts, references, computer packages, etc.)

5.1 Bernstein PL. 1998. *Against the Gods: The Remarkable Story of Risk.* Wiley: New York NY.
5.2 Stern P, Fineberg H, eds. 1996. *Understanding Risk: Informing Decisions In a Democratic Society*. National Research Council: Washington DC.
5.3 Krimsky S, Golding D, eds. 1992. *Social Theories of Risk.* Praeger: Westport CT.
5.4 Taylor-Gooby P, Zinn JO, eds. 2006. *Risk in Social Science.* Oxford Univ. Press: Oxford UK.
5.5 Anderson DR. 2005. *Corporate Survival: The Critical Importance of Sustainability Risk Management*. iUniverse: Lincoln NE.
5.6 Vallero DA, Vesilind PA. 2006. *Socially Responsible Engineering: Justice in Risk Management*. Wiley: New York NY.

6.0 Topics (outline):

6.1 Knowledge, ignorance and uncertainty
- 6.1.1 Probability theory
  - 6.1.1.4 Information as change in probability assignment
    - 6.1.1.4.1 The Monty Hall problem
    - 6.1.1.4.2 Computing inverse probabilities (1-p)
  - 6.1.1.5 Markov chains
  - 6.1.1.6 Monte Carlo analysis
  - 6.1.1.7 Process-based versus outcomes-based probability estimation
  - 6.1.1.8 Case study: Richard Feynman and the *Challenger* investigation
- 6.1.2 Determinism vs. variability vs. uncertainty
- 6.1.3 Ignorance

6.2 Utility Theory
- 6.2.1 Utility = probability * payoff
- 6.2.2 Non-linear utility functions (e.g., lottery preferences)
- 6.2.3 Limitations on utility theory
  - 6.2.3.4 Pascal's wager
  - 6.2.3.5 Irrevocable consequences (e.g., medicine, environment)
    - 6.2.3.5.1 Pascal's roulette strategy
    - 6.2.3.5.2 Chemo or no chemo?
    - 6.2.3.5.3 Species extinction/liquidation
    - 6.2.3.5.4 Case study: Nauru
- 6.2.4 Decision-making strategies in the absence of utility maximization
  - 6.2.4.4 Attitudes and tolerance for risk
  - 6.2.4.5 Maxi-min
  - 6.2.4.6 Maxi-max
- 6.2.5 Problems with eliciting utility functions
  - 6.2.5.4 Monetizing without markets
    - 6.2.5.4.1 Contingent valuation
    - 6.2.5.4.2 WTP v. WTA
    - 6.2.5.4.3 Conjoint analysis
  - 6.2.5.5 Lexicographic preference ordering
- 6.2.6 Decision-making strategies in the absence of utility functions (i.e., introduction to multi-criteria decision analysis)
  - 6.2.6.4 The performance table
  - 6.2.6.5 MAVT
  - 6.2.6.6 MAUT
  - 6.2.6.7 Outranking
  - 6.2.6.8 SMAA
  - 6.2.6.9 Compensatory v non-compensatory methods

6.3

6.4 Finance
- 6.4.1 Time value of money
  - 6.4.1.4 Understanding interest, compounding periods and equivalence of different interest rates
  - 6.4.1.5 Derivation of the exponential discount rate
  - 6.4.1.6 Net present value analysis: drawing different types of cash flow diagrams, identifying the correct formulae for net present value analysis, reconciling different analysis periods and strategies for problem solving (e.g., bonds and mortgages)
  - 6.4.1.7 Infinite time series
- 6.4.2 Sunk vs. opportunity costs
  - 6.4.2.4 Internal rate of return
  - 6.4.2.5 Minimum rate of return as an opportunity cost
  - 6.4.2.6 Payback period
  - 6.4.2.7 Break-even analysis (e.g., incandescent vs. compact fluorescent bulbs)
- 6.4.3 Where do discount rates come from?
  - 6.4.3.4 Opportunity costs (e.g., interest rates)
  - 6.4.3.5 Inflation (e.g., expected price or income increases)
  - 6.4.3.6 Risk (e.g., Treasury yield curve)
  - 6.4.3.7 Hyperbolic discount rate and behavioral finance
    - 6.4.3.7.1 Procrastination
    - 6.4.3.7.2 Drug addiction
    - 6.4.3.7.3 "Social" or aggregated discount curves
- 6.4.4 Effects of inflation
- 6.4.5 Depreciation
  - 6.4.5.4 Concept of salvage value
  - 6.4.5.5 Straight-line
  - 6.4.5.6 Sum-of-the-years
  - 6.4.5.7 MACRS
- 6.4.6 Taxes
- 6.4.7 Example: automobile acquisition: purchase vs. lease.
- 6.4.8 Examples in financial risk analysis
  - 6.4.8.4 Automobile insurance
  - 6.4.8.5 FICO credit scores
  - 6.4.8.6 Corporate & government bond ratings
  - 6.4.8.7 Life insurance
- 6.4.9 Option values

6.5 Environmental Risk Assessment
- 6.5.1 The Toxicological Risk Model
  - 6.5.1.4 Source (e.g., Toxic Release Inventory)
  - 6.5.1.5 Fate & transport
  - 6.5.1.6 Exposure
    - 6.5.1.6.1 Inhalation

6.5.1.6.2 Dermal
6.5.1.6.3 Ingestion
6.5.1.7 Dose
6.5.1.8 Response endpoints
6.5.1.8.1 Lethality (e.g. LD50)
6.5.1.8.2 Cancer
6.5.1.8.3 Neurotoxin
6.5.1.8.4 Reproductive health
6.5.2 Dose-response relationships
6.5.2.4 Toxic thresholds
6.5.2.4.1 Importance of detection limits
6.5.2.4.2 Example: history of lead
6.5.2.5 Micro-nutrients
6.5.2.6 No safe limit (e.g., radioactivity, lead, mercury)
6.5.2.7 The inverted "U"
6.5.3 Ecotoxicology
6.5.3.4 Bioaccumulation

6.6 Socio-political issues in risk assessment (see Vallero DA, Vesilind PA. 2006. *Socially Responsible Engineering: Justice in Risk Management*. Wiley: New York NY.)
6.6.1 Environmental Impact Statements
6.6.2 Environmental justice
6.6.3 Perceptions of risk
6.6.3.4 Risk analysis v. risk feelings
6.6.3.5 Voluntary vs. imposed risks
6.6.3.6 "Framing" risk
6.6.4 Examples in "social" risk mismanagement?
6.6.4.4 Supply chain practices
6.6.4.5 The *Feld Spar*?
6.6.4.6 Product attribute assessment

6.7 Risk Management

6.8 Risk Communication

7.0 Intended learning outcomes and associated assessment methods of those outcomes

7.1 Understand fundamentals of finance as related to risk analysis
A. Learning activity: Students will complete reading, library research and mathematical problem-solving homework assignments in net-present-value analysis, and options analysis and will explore the sensitivity of cost-benefit analysis to discount rates and models, culminating in an exam including essay questions and mathematical problems.
B. Assessment: Students must earn a satisfactory grade on the exam.

Grading criteria will include frequency of correct answers, conceptual completeness and demonstrated depth of understanding.

7.2 Understand the fundamentals of toxicological risk assessment

A. Working in small groups, student will complete assigned reading and research the toxicological history of a compound or contaminated site of their choice such as tetra-ethyl lead, polybrominated diphenyl ethers, polychlorinated biphenyls, trichloroethylene, Love Canal NY, Woburn MA or others and present the results of their findings to the class.

B. Assessment: Students must earn a satisfactory grade on the group presentation. Grading criteria will include accuracy, originality, clarity and quality of presentation.

7.3 Understand basic socio-political dimensions of risk

A. Learning Activity: Working with a partner, students will complete reading assignments and select a contemporary issue in which to organize a debate. Students will prepare brief position papers and summarize their arguments in brief presentations. Students will cross-examine one another and be subject to the cross-examination of the Instructor.

B. Assessment: Students must earn a satisfactory grade on the aggregated brief, presentation and cross-examination. Grading criteria will include accuracy, originality, clarity and quality of presentation as well as strength of evidence in support of the position, and logical consistency under cross-examination.

7.4 Be prepared for further study in sustainability

A. Learning Activity: Working as a class, students will participate in discussion of reading assignments, organize a multidisciplinary workshop for discussion of risk from multiple perspectives and prepare a broader impacts statement regarding the potential consequences of their research from a sustainability risk perspective.

B. Assessment: Students must earn a satisfactory grade (A or B for graduate students) on their workshop, group discussion and broader impacts statement. Grading criteria will include:

a. frequency and quality of contributions to discussion.
b. success of the workshop, from the standpoint of organization and participation from faculty and students outside the registered class participants and
c. quality with which multiple aspects of risk are integrated within their broader impacts statement.

8.0 Program or general education goals supported by this course

This course will support graduate and undergraduate education objectives in several RIT programs that relate to the environment, business, production, and policy. Furthermore, this course directly supports several program objectives in the proposed Golisano Institute for Sustainability Ph.D. and M.S. programs, such as:

8.1 Specify quantifiable sustainability objectives and strategies for achieving them.

8.2 Model and improve complex industrial-environmental-social systems with respect to sustainability objectives.

8.3 Define and conduct forward-looking sustainability research.

8.4 Lead multidisciplinary teams working on sustainability issues.

8.5 Conduct life cycle assessments (LCA).

8.6 Create new sustainable production/remanufacturing/recycling methods and improve existing ones.

9.0 Other relevant information (such as special classroom, studio, or lab needs, special scheduling, media requirements, etc.)

10.0 Supplemental information

None.

11.0 Endnotes.

None.

64. Urban Systems and Sustainability

University of California, Davis

SUMMARY

Offered by: Civil and Environmental Engineering
Instructor(s): Frank Loge

Number of times taught: Three or More
Class size: 30 to 100
Class format: 3 hours of lecture plus x hours of X plus x hours of "other" contact per week

Portion of course focused on sustainable engineering: More than 50%

Student Level: Undergraduate, upper and lower division (7:3)
Students' Major: 30% Civil and Environmental Engineering
10% Other engineering
60% Non engineering

ECI-123: Urban Systems and Sustainability, Fall, 2006
Department of Civil and Environmental Engineering
University of California Davis

Instructor: Frank Loge
3163 ENG III (754-2297); email: fjloge@ucdavis.edu
Office Hours: M, W: 4:30-5:30; T, Th: 4:00-5:00; or by appointment.

Location/Schedule: T, R (12:10 – 2:00 p.m.) in Chem 179
Final exam on Tuesday, December 12 (10:30 - 12:30)

Textbooks:

1. Orr, David W. 2002. The Nature of Design: Ecology, Culture, and Human Intention. Oxford University Press, NY. ISBN: 0-19-514855-X. (On Reserve)
2. Nash, R. F., and P. F. Barlett (2005) Urban Place : Reconnecting With the Natural World (Urban and Industrial Environments). The MIT Press. ISBN: 0262524430. (On Reserve)
3. Beatley, T. and K. Manning (1997) The Ecology of Place: Planning for Environment, Economy and Community. Island Press. Covelo, CA. ISBN: 1-55963-478-2. (On Reserve)

References:

Sustainability

- Beatley, T. (2000) Green urbanism: learning from European cities. Island Press. Covelo, CA. ISBN: 1-55963-682-3. (On Reserve)
- Gottdiener, M., and R. Hutchison (2000) The new urban sociology. Second Edition. McGraw-Hill Press. New York. ISBN: 978-0-8133-4318-1 or 0-8133-4318-6. (On Reserve)
- Jackson, J.B. (1975) Discovering the vernacular landscape. Yale University Press. New Haven, CT. ISBN: 0-300-03581-0. (On Reserve)
- Jacobs, J. (1992) The earth and life of great American cities. Vintage Press. New York. ISBN: 0-679-60047-7. (On Reserve)
- Johnson, B. and K. Hill (2001) Ecology and design: frameworks for learning. Island Press. Covelo, CA. ISBN: 1-55963-813-3. (On Reserve)
- Judd, D. and S. Fainstein (1999) The tourist city. Yale press. New Haven, CT. ISBN: 0-300-07846-3. (On Reserve)
- Kibert, C. J. (1999) Reshaping the built environment: ecology, ethics and economics. Island Press. Covela, CA. ISBN: 1-55963-701-3 or 1-55963-702-1. (On Reserve)
- Klinenberg, E. (2002) Heat wave: A social autopsy of disaster in Chicago. University of Chicago Press. Chicago. ISBN: 0-226-44321-3. (On Reserve)
- Lyle, J. T. (1999) Design for human ecosystems: landscape, land use, and natural resources. Island Press. Covela, CA. ISBN: 1-55963-720-X. (On Reserve)
- McHarg, I. L. (1992) Design with nature. John Wiley and Sons, Inc. New York. ISBN: 0-471-55797-8 or 0-471-11460-X. (On Reserve)
- Ndubisi, F. (2002) Ecological planning: a historical and comparative synthesis. Johns Hopkins University Press. Baltimore. ISBN: 0-8018-6801-7. (On Reserve)

- Register, R. (2002) Ecocities: building cities in balance with nature. Berkeley Hills Books. Berkeley. ISBN: 1-8931-6337-7. (On Reserve)
- Spirn, A. W. (1984) The granite garden: urban nature and human design. Basic Books. ISBN: 0-465-02706-7 or 0-465-02699-0. (On Reserve)
- Spirn, A. W. (1998) Language of landscape. Yale University Press. New Haven, CT. ISBN: 0-300-08294-0 or 0-300-07745-9. (On Reserve)
- Steiner, F. (2002) Human ecology: following natures lead. Island Press. Covelo, CA. ISBN: 1-55963-995-4. (On Reserve)
- Vale, L. and T. Campanella (2005) The resilient city: how modern cities recover from disaster. Oxford University Press. Oxford. ISBN: 0-1951-7583-2. (On Reserve)
- Van der Ryn, S. and S. Cowan (1996) Ecological design. Island Press. Covelo, CA. ISBN: 1-55963-389-1 or 1-55963-399-3. (On Reserve)
- Babbitt, B. (2005) Cities in the Wilderness: A New Vision of Land Use in America. Island Press. ISBN: 1559630930. (On Reserve)
- Leopold, A. (1966) Sand County Almanac (Outdoor Essays & Reflections). Ballantine Books. ISBN: 0345345053. (On Reserve)
- Forman, R. T. and D. Sperling () Road ecology: science and solutions. Island Press. ISBN: 1-55963-933-4 (Not on Reserve)
- Mendler, S. F., and W. Odell (2006) The HOK Guidebook to Sustainable Design. John Wiley and Sons, Inc. ISBN: 978-0-471-69613-1 or 0-471-69613-7. (On Reserve)
- Brown, D. E., M. Fox, M. R. Pelletier, and L. Hoffman (2001) Sustainable architecture white papers. Earth Pledge Foundation. ISBN: 0967509912. (On Reserve)
- Benyus, J. M. (1998) Biomimicry: innovation inspired by nature. Perennial (HarperCollins); Reprint edition (May 1998). ISBN: 0060533226. (On Reserve)
- Dubos, R. J. (1981) The Wooing of Earth (Wooing of Earth SL). Scribner Book Company. ISBN: 0684169517. (On Reserve)
- McLennan, J. F. (2004) The Philosophy of Sustainable Design. Ecotone Publishing Company LLC. ISBN: 0974903302. (On Reserve)

Ecological Footprint

- Wackernagel, M. and W. Rees (1996) Our Ecological Footpring: Reducing Human Impact on the Earth. Gabriola Island, BC: New Society Publishers. (On Reserve)
- Chanbers, N. (2000) Sharing Nature's Interest: Ecological Footprints as an Indicator of Sustainability. London: Earthscan Publishers. (On Reserve)
- Rees, William E. 1992. "Ecological footprints and appropriate carrying capacity: what urban economics leaves out." Environment and Urbanization, 4(2): 121-130. (Available electronically on the course website).

Energy

- Malkina-Pykh, I. G. and Y. A. Pykh (2002) Sustainable Energy: Resources, Technology, and Planning. WIT Press, Great Britain. ISBN: 1-85312-939-9. (On Reserve)

- Dewulf, J., H. V. Langenhove (EDS) (2006) Renewables-Based Technology: Sustainability Asessment. Gabriola Island, BC, Canada. ISBN: 13978-0-470-02241-2. (On Reserve)
- Flavin, C. and N. Lenssen (1994) Power Surge: Guide to the Coming Energy Revolution. W.W. Norton & Company, Inc., New York. ISBN: 0-393-03678-2. (On Reserve)
- Schaeffer, J. (2005) Solar Living Source Book: Your Complete Guide to Renewable Energy Technologies and Sustainable Living. New Society Publishers Limited, Gabriola Island, BC, Canada. ISBN: 0-916571-05-X. (On Reserve)

Food

- Pretty, J. (1998) Supportive policies and practice for scaling up sustainable agriculture, In N. G. Roling and M. A. E. Wagemakers, Facilitating Sustainable Agriculture, Cambridge University Press, UK. ISBN: 0-521-58174-5. (Available electronically on the course website).
- Pretty, J. (2002) Agri-Culture: Reconnecting People, Land, and Nature. Earthscan, Sterling, VA. ISBN: 1-85383-920-5. (On Reserve)
- Vorley, W. and D. Keeney (Eds) (1998) Bugs in the system: Redesigning the pesticide industry for sustainable agriculture. Earthscan Publications, Ltd., London. ISBN: 1-85383-430-0. (On Reserve)
- Lampkin, N. H. and S. Padel (Eds) (1994) The Economics of Organic Farming: An International Perspective. CAB International, Wallingford, UK. ISBN: 0-85198-911X. (On Reserve)
- VanLoon, G. W., S. G. Patil, and L. B. Hugar (2005) Agricultural Sustainability: Strategies for Assessment. Sage Publications, New Delhi. ISBN: 0-7619-3340-9. (On Reserve)

Waste

- Tchobanoglous, G. and F. Kreith (2002) Handbook of Solid Waste Management. McGraw-Hill, New York. (On Reserve)
- Tchobanoglous, G., F. L. Burton, H. D. Stensel. 2003. Wastewater Engineering: Treatment and Reuse. Metcalf and Eddy. (On Reserve)
- W. McDonough and M. Braugart. 2002. Cradle to Cradle. Northpoint Press. ISBN 0-86547-587-3. (On Reserve)
- Young, J. E. and A. Sachs (Eds). The next efficiency revolution : creating a sustainable materials economy. Washington, DC: Worldwatch Institute, c1994. (On Reserve)
- Weinberg, A. S., D. N. Pellow, and A. Schnaiberg. Urban recycling and the search for sustainable community development. Princeton, N.J.: Princeton University Press, c2000. (On Reserve)

Water

- European Union, Regional Policy Commission (2000) "Towards sustainable and strategic management of water resources." Luxembourg: Office for Official Publications of the European Communities; Lanham, Md.: Bernan Associates (distributor). Part of the series "Regional development studies (Brussels, Belgium)"; v. 31. (On Reserve)

- Erie, Steven P. Beyond Chinatown : the Metropolitan Water District, growth, and the environment in southern California. Stanford, Calif., Stanford University Press, 2006. (On Reserve)
- Gleick, P. H. et al. California water 2020: a sustainable vision. Oakland, CA : Pacific Institute for Studies in Development, Environment, and Security, c1995. (On Reserve)
- Energy and water for sustainable living : a compendium of energy and water success stories / prepared by Argonne National Laboratory for U.S. Department of Energy, U.S. Department of State, and U.S. Agency for International Development. [Washington, D.C. : U.S. Dept. of Energy, 2002]. (On Reserve)
- MacDonnell, L. J. From reclamation to sustainability : water, agriculture, and the environment in the American West. Niwot : University Press of Colorado, c1999. (On Reserve)
- Guidelines on water and sustainable development: principles and policy options. Economic and Social Commission for Asia and the Pacific. New York : United Nations, 1997. (On Reserve)
- Kenney, D. S. (Ed) In search of sustainable water management: international lessons for the American West and beyond. Cheltenham, UK ; Northampton, MA: Edward Elgar Pub., c2005. (On Reserve)
- Owens-Viani, L., A. K. Wong, P. H. Gleick. Sustainable use of water : California success stories. Oakland, Calif. (654 13th St., Preservation Park, Oakland 94612): Pacific Institute for Studies in Development, Environment, and Security, c1999. (On Reserve)

Prerequisites: Upper division standing.

Class Structure:
The principal objective of this class is to provide a background and understanding of the principals of sustainable urban systems. The course will specifically focus on definitions of sustainability; ecological design; ecological footprints; urban place; and sustainable practices associated with the production and consumption of food, water, and energy, and disposal of waste. Basic concepts in each of these areas will be highlighted in a series of field trips. Specific concepts will be explored in detail in a course project (described below). The course is highly participatory, and will require you to actively engage each other and the instructor both in and out of the classroom. I will provide handouts on a periodic basis to supplement information in the textbooks. At the end of this course, you should have a much deeper appreciation of how to build decent communities in which people grow to be responsible citizens and whole people who do not confuse what they have with who they are.

Project:
All individuals require food, water, energy, and waste disposal (referred to as Basic Needs throughout this course). In the United States, we take for granted that these basic needs will be met, and we focus on other aspects of our lives. Currently, our basic needs are met using large-scale systems and global organizations with technologies and practices created on assumptions that nature is inexhaustible and that human actions counted for little. A fundamental tenet of sustainable urban systems is that local economies prosper, both for current and future generations, by minimizing dependency on the outside economy and by meeting local needs with local resources. The course project is designed to illustrate specifically what is meant by this tenet, as

well as other concepts discussed in class and your textbooks, through active participation in, and evaluation of, your life. For the course project, you will be asked to track your consumption of food, water, and energy, and disposal of waste, for one week. You will then be asked to pick one area and analyze it in depth. You will then make a significant change in that one area throughout the rest of the quarter, and document the impact of that change has on the sustainability of that one area on a local, regional, and national scale. The projects will be completed individually for Deliverables 1-3, and in 4 groups for Deliverable 4. Specific details of the project are provided below.

Deliverable 1
Keep a personal diary for one week and track your consumption of food, water, energy, and production of waste products. Consolidate your diary into a table (using Excel or Word) that lists quantities per day for each category, with a total for each category at the end of the week. Compose a 3-5 page report that summarizes your methods and results, and discuss whether or not you believe these quantities are significant (consider scale in the discussion).

Deliverable 2
Pick one major impact area (food, water, energy, or waste). Analyze it in depth. Issues to consider include:

- Where does it come from.
- What is involved in production.
- What types of impacts doe production have on air, water, soil, local ecology, and social/economic structure of the local community.
- What is involved in getting the product to you (or in the case of waste, to its final resting site).
- What impacts are associated with transport to or away from you.
- What impacts are associated with your use.

Data sources to consider include: (1) a field trip to a typical site, (2) literature, and (3) the internet. Summarize your findings in a report (max 10 pages excluding tables, figures, and references).

Deliverable 3
Make a significant change in your life for the rest of the quarter in the one area you selected under Deliverable 2. Document what takes place in your life as you did in Deliverable 1. Calculate the impact that this change by comparing what took place after this change relative to what took place before you made this change. Identify and then apply methods of characterizing the impact of this change on the economy, social structure, ecology, and environment. Summarize your findings in a report (max 10 pages excluding tables, figures, and references).

Deliverable 4
Analyze how the change you made in your life might be implemented at a larger scale. Consider:

- Scale (from individual to community to national/global).
- Cultural values.
- Education.
- Root causes versus superficial solutions.
- Other cultures as examples for how things could be different (e.g., Amish, Native Americans).

Individuals will be grouped into 4 categories corresponding to the 4 possible topical areas of your project (water, food, energy, or waste). Each group will present their findings for this deliverable as a 45 minute Powerpoint presentation during class. Findings from Deliverables 1-3 should be

used as introductory material for each presentation. Each group will have to coordinate regular meetings to meet this deliverable. If this type of group project is viewed as not feasible, alternative venues for presenting your work are possible and can be discussed in class if needed.

Grading Criteria:

Project: Deliverable 1	10%
Project: Deliverable 2	35%
Project: Deliverable 3	35%
Project: Deliverable 4	20%

For each project deliverable, your performance will be evaluated based on: (1) the technical aspects of your writing (20%); (2) content (60%); and (3) passion (20%), defined as courage, good-heartedness, creativity, and your larger vision of how we might integrate human societies into natural systems. Final letter grades will be assigned "on the curve", but cutoffs for the various letter grades usually don't drop more than 2 points below the typical "decade" values of 90, 80, 70, etc.

Exams:
There is no midterm or final associated with this course.

Listserv:
The listserv for the class is eci123-f06@ucdavis.edu. You will automatically be enrolled on this list if you are registered for the class and have a campus e-mail address. If you don't have a campus e-mail address, you must obtain one. [Go to IT Express, located in room 182 of Shields Library (turn right inside the main entrance and go a few doors down) and bring a photo ID with you.] I will use this to let you know when I post items to the course website, as well as to broadcast questions and answers relevant to the class as a whole. I expect that you will check your email regularly. You are also welcome to send messages to the list yourself.

The software for establishing the class mailing list automatically uses your UC Davis e-mail address. It is not possible to substitute a different address. If you want to receive messages at a different address, you should set up your UCD account to forward to that desired address. See http://email.ucdavis.edu/forms/mailidredirect.html for instructions on how to do this.

Website:
For those registered in the class, the course web site can be accessed through your MyUCDavis portal, http://my.ucdavis.edu. If you are not registered (e.g. auditing), go to http://classes.ucdavis.edu/login/CourseManagement/Website/course_search.cfm and browse "Engineering Civil and Environ" (or by instructor) for ECI 123. The following items can be viewed and downloaded online from the course web site: (1) copies of the lecture when powerpoint is used, (2) updated copies of the syllabus (which changes from the most previous version highlighted in red), (3) supplemental reading material, and (4) information relevant to the project.

Lecture and Reading Schedule

Date	Topic	Reading[a]
9/28	Introduction	Orr: 1-12 Be: 1-26 Ba: 1-34
10/3	Syllabus and Project Overview What is Sustainability?	Orr: 13-34 Be: 27-39
10/5	Is there a Problem? **Project Deliverable 1 Assigned**	Orr: 35-126 Ba: 237-298
10/10	Walking Tour of Ecology and Natural History of Davis	Ba: 213-234, 173-188
10/12	Ecological Design	Be: 40-85
10/17	Food **Project Deliverable 1 Due** **Project Deliverable 2 Assigned**	Ba: 117-172
10/19	Field Trip: Capay Valley Organic Farm	
10/24	Field Trip: Superior Farms Meat Processing, Dixon	
10/26	Waste	Handouts
10/31	Field Trip: Yolo Landfill and Methane Production/Electrical Generation **Project Deliverable 2 Due** **Project Deliverable 3 Assigned**	
11/2	Field Trip: UCD Wastewater Treatment Plant	
11/7	Water	Handouts
11/9	Field Trip: Carmichael Water District	
11/14	The Ecology of Place	Be: 86-136 Ba: 39-60, 91-116 Handouts
11/16	Building a Restorative Economy	Be: 137-170 Handouts
11/21	The Civic Community **Project Deliverable 3 Due** **Project Deliverable 4 Assigned**	Be: 171-193 Handouts
11/23	**Thanksgiving Holiday**	
11/28	Conclusions	Be: 194-232 Ba: 299-320 Handouts
11/30	**Project Deliverable 4 Due** Student Presentations	Handouts
12/5	Student Presentations	Handouts
12/7	Student Presentations	Handouts
12/12	**Final** (10:30-12/30)	Handouts

[a] Orr = Orr, David W. 2002. The Nature of Design: Ecology, Culture, and Human Intention.
Be = Beatley, T. and K. Manning (1997) The Ecology of Place: Planning for Environment, Economy and Community.
Ba = Nash, R. F., and P. F. Barlett (2005) Urban Place : Reconnecting with the Natural World (Urban and Industrial Environments).

65. Wind Power

Cornell University

SUMMARY

Offered by: Mechanical and Aerospace Engineering
Instructor(s): Sidney Leibovich and Zellman Warhaft

Number of times taught: Once
Class size: 10 to 30
Class format: 3 hours of lecture per week

Portion of course focused on sustainable engineering: Less than 10%, 10 to 25%, 25 to 50%, More than 50%

Student Level: Upper division and graduate (9:1)
Students' Major: ≥90% Mechanical and Aerospace Engineering

Department, number, and title of course: Mechanical & Aerospace Engineering MAE 402, Wind Power

Designation as a 'Required' or 'Elective course: Elective

Course (catalog) description: Fall. 3 credits

Main features of energy conversion by wind turbines. Emphasis on characterization of the atmospheric boundary layer, aerodynamics of horizontal axis wind turbines, and performance prediction. Structural effects, power train considerations, siting and wind farm planning.

Prerequisite(s): MAE 323 or MAE 305, MAE 325.

Textbook(s) and/or other required material: *Wind Energy Explained: Theory, Design and Application,* J. F. Manwell, J.G. McGowan, and A. I. Rogers

Course objectives:
On completion of this course, students should:

1. Understand the need for carbon-free energy production and the functions of wind turbines (ABET f, j)
2. Be able to calculate mean wind fields (ABET a, b)
3. Analyze the aerodynamics of wind turbine blades (ABET a)
4. Predict efficiency of energy extraction (ABET a, e, k)
5. Estimate blade loading and mechanical response (ABET a, e)
6. Know how to choose sites for turbines and wind farms (ABET a, e)
7. When taken with corresponding section of MAE 429, demonstrate the ability to design a wind power system or component (ABET c)

Topics covered:

- Introduction. World and national energy demand. Global environmental impact: the greenhouse effect and greenhouse gases. Carbon neutral energy sources. Wind energy history.
- Characterization of the wind: Generation of planetary winds. The atmospheric boundary layer, and atmospheric turbulence. Flow over terrain. Geographical distribution of mean wind, and statistical characteristics at given locations.
- Aerodynamics of wind turbines: Actuator disc analysis. Inclusion of wake rotation. Airfoils. Blade element analysis. Wind shear and unsteady effects.
- Loading of rotor structure and mechanical response. Aeroelastic response, Vibrations, fatigue. Tower loads.
- Wind turbine siting, energy storage. Offshore installations. Turbine wakes, and wind farms

Class/laboratory schedule, i.e., number of sessions each week and duration of each session: Three 50-minute lectures each week.

Contribution of course to meeting the professional component: This course partially fulfills the requirement to complete three upper level M&AE courses as a Field Approved Elective. It may also be used to fulfill the Technical Elective requirement.

Relationship of course to program outcomes: This course meets ABET Outcomes a, b, e, and k and Program Educational Objectives 1, 2, and 4. When taken with the corresponding section of MAE 429, it partially satisfies ABET outcome c.

Outcome Assessment:

- Knowledge of fundamental principles is assessed by homework assignments, two prelims, and a final examination (Objectives 1, 2, 4)
- Competence in problem identification, formulation, and solution will be assessed by open ended problem assignments
- Competence in use of techniques and tools of modern engineering practice will be assessed by ability to employ computational tools such as software distributed by NREL
- At the end of the course, students will be asked to complete the course evaluation form supplied by the College.

Person(s) who prepared this description and date of preparation:
Sidney Leibovich
April 11, 2007, Revised Dec. 10, 2007

See 3 companion Word documents for remainder of this Appendix