Course Syllabus

WEN502 – Systems Perspectives on Industrial Ecology

Water and Environmental Engineering Program

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1 Overview

1.1 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. While this is very relevant, as a core course, to Water and Environmental Engineering students, it is also very helpful to students from other disciplines.

1.2 Learning Outcomes and Assessment Methods

1.2.1 Learning Outcomes
1. Understand the concept of industrial ecology and its relation to the impacts of industrial processes on the environment.
2. Understand the various stages of a life-cycle assessment (LCA) (e.g., scope definition, inventory analysis, etc) and their relevance to environmental evaluation process.
4. Ability to conceive and compare processes, systems, or products in terms of their environmental products using LCA tools.
5. Ability to work in project teams and to communicate project results effectively and professionally in written and oral forms.

1.2.2 Assessment Methods
There are no traditional “exams” in this course. Assessment is done through homework assignments (mini-projects) and three main projects. Specifically, the assessments methods include:
1. Written assignment on definitions of industrial ecology and application to particular products and/or industries.
2. Assignment on life-cycle inventory for a product using SimaPro software and inventory databases.
3. Case study (presentation and report) of the life-cycle impacts of a manufactured product and recommendations for product improvement.

1.3 Course Resources

1.3.1 Course Readings
Because the course covers a broad range of topics, there is no single comprehensive textbook. However, copies of the key reference: “The Hitchhiker’s Guide to LCA – An orientation in Life Cycle Assessment Methodology and Application” is made available to all students to check-out of library as one main source on LCA. Thus, for course readings, students will be expected to consult:
- Reading materials, which will be provided on the course web site;
- Lecture slides for the course, which will be provided on the course web site.

A reading list is provided at the end of the syllabus.
1.4 Computing Environment

1.4.1 Course Management
A course management website will be used for overall management on the course. The website is on Masdar Institute’s Moodle system.

This website is the primary means of distributing basic information about the course:
- Syllabus and Schedules of classes and the readings and assignments;
- Copies of Lecture Slides used in the lectures.

NOTE: Participants are expected to use email regularly to keep up with messages about the course from instructors. Messages sent by email will be considered to have been available to everyone.

1.4.2 Course Software
The case study projects for the course will rely heavily on SimaPro, a Life Cycle Analysis software commonly used among LCA professionals. Assignments will be given that cover tutorials and an introduction to the software.

1.5 Grading Policy
Grades will be based on various assignments throughout the term. Their weights are:
- HW Assignments: 30%
- LCA project 1: 10%
- LCA project 2 (Oral presentation, no report): 20%
- LCA project 3:
  - Oral presentation 10%
  - Final Report 20%
- Class Participation 10%

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.

Since the grading in this course will be mostly done based on homework assignments and course projects, it is very important that the students be informed of the criteria applied when grading each of these assignment types. They are as follows:

Homeworks: the main criteria for HW grading are:
- Analytical and critical comprehension and presentation of information
- Relevance of presented information
- Accuracy of calculations (for HWs involving calculations)
- Completeness and accuracy of provided answers
- Validity and justification of assumptions, when made.
- Thoroughness in searching the information (but without exceeding page limits)
- Reflection of good understanding and application of course concepts taught in the HW assignment

Projects: the main criteria for project grading are:
- Originality in the selection of the alternatives for the comparative LCA
- Creativity and depth in developing change scenarios for LCA comparisons (project 3)
- Inclusion of essential LCA elements (Functional unit, scope,
• Clarity of system description (including system boundaries)
• Thoroughness of inventory analysis
• Legitimacy of assumptions and their justification
• Quality and depth of results discussion (especially for impact assessment)
• Final recommendations (logic, clarity, support within study)
• Discussion of study limitations
• Data presentation (clarity, effectiveness, etc)
• Report formatting (including citations, language, effective utilization of page limit, etc)
• Handling questions (during oral project presentations)

1.5.1 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.

1.5.2 Work in Teams
Students will work in teams for the unit projects and some homeworks. Indeed, we encourage this collaboration because it can lead to more interesting results. However, the team members bear the responsibility of coordinating their workload and resolving any group-work-related issues.

1.5.3 Academic Honesty:
Most 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 wording of sentences, etc.) will result in zeros for each paper with this evidence.

1.6 Class Schedule Spring 2013

<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Day</th>
<th>Topic</th>
<th>Homework assigned</th>
<th>Homework Due</th>
<th>Readings Due</th>
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<tbody>
<tr>
<td>1</td>
<td>21/1</td>
<td>Monday</td>
<td>Course Introduction</td>
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<td>2</td>
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<td>3</td>
<td>28/1</td>
<td>Monday</td>
<td>Why Industrial Ecology?- Role of Engineers</td>
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<td>Frosch &amp; Gallopoulos, 1989; Frosch, 1992; Graedel, 1996;</td>
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<td>4</td>
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<td>Thursday</td>
<td>What is Industrial Ecology?(pt 1): Definitions and Relation to Sustainability</td>
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<td>Tillman – Ch1; Ehrenfeld &amp; Gertler, 1997.</td>
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<td>4/2</td>
<td>Monday</td>
<td>What is Industrial Ecology?(pt 2): Industrial Ecoparks and Other Examples</td>
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<td>6</td>
<td>18/2</td>
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<td>Life Cycle Assessment – Inventory Concepts</td>
<td>Projects introduced</td>
<td>HW 2</td>
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<td>Environmental Evaluation - An Overview</td>
<td>HW 2</td>
<td>HW 1</td>
<td>Tillman – Ch3</td>
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<td>Life Cycle Assessment – Inventory Allocation</td>
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<td>Environmental Paradigms</td>
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<td>Janssen and Rotmans, 1994;</td>
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<td>Intro to Impact Assessment</td>
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<td>Tillman – Ch5; Bengtsson &amp; Steen, 2000;</td>
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1.7 Other logistics

1.7.1 Class time/location
Monday-Thursday, Classroom 4, 2:45-4:00 PM

1.7.2 Office hours:
Due to the dynamic nature of the work at Masdar Institute (meetings, research activities, etc), setting office hours that cannot be broken may be difficult. So, the students are welcome to stop by the Dr. Arafat’s office at any time for questions, etc. If the student prefers to setup an appointment beforehand with Dr. Arafat, that would also be fine.

1.7.3 Teaching Assistants:
This course has two teaching assistants, Tariq Al-Sarkal (talsarkal@masdar.ac.ae) and Sanaa Pirani (spirani@masdar.ac.ae). Tariq will be in charge of handling issues related to the SimaPro software (training, student questions), while Sanaa will help with homework grading. Project and participation grading as well as final grade determination rests entirely with Dr. Arafat.

1.8 Reading List


1.9 Acknowledgements
This course has been developed with assistance from Frank Field, Jeremy Gregory, and Randolph Kirchain at the Massachusetts Institute of Technology and Scott Kennedy from Masdar Institute. The course content and format is based upon “Systems Perspectives on Industrial Ecology” ESD.123/3.560 offered at MIT in the Engineering Systems Division and the Department of Materials Science and Engineering.