University of California, Berkeley
Department of Mechanical Engineering

ME 290K B: Life Cycle Thinking in Engineering Design (1 unit)

Graduate Course

Syllabus

CATALOG DESCRIPTION

How do we design and manufacture greener products, and how do we know if they really are? This class both provides tools for sustainable design innovation and metrics to measure success. Students will use both creative and analytical skills, generating new ideas as well as evaluating designs with screening-level life cycle assessment.

COURSE PREREQUISITES

Graduate level standing; Prior design course.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

No formal textbook. Sample readings are:

- J. Faludi and A. Mentor, *Lifecycle Assessment Primer*, http://students-stg.autodesk.com/?nd=sustainable_standard&material_id=111&course_id=1
- EPA tutorial "Life Cycle Assessment: Principles and Practice", http://www.epa.gov/nrmrl/std/lca/lca.html
- J.C. Ryan and A. T. Durning, *Stuff: The Secret Lives of Everyday Things*
- J. C. Ryan, *Seven Wonders: Everyday Things for a Healthier Planet*
- P. Hawkin, A. Lovins and L. H. Lovins, *Natural Capitalism, The Next Industrial Revolution;* available online at http://www.natcap.org/sitepages/pid5.php
- 10xE Principles, Rocky Mountain Institute, http://www.rmi.org/rmi/10xe+principles
- Andrew Savitz and Karl Weber, *The Triple Bottom Line*
- "The Cradle to Cradle Alternative", http://www.mcdonough.com/writings/cradle_to_cradle-alt.htm
- Autodesk, Whole Systems and Lifecycle Thinking Quick Reference Guide, http://students-stg.autodesk.com/?nd=sustainable_standard&course_id=1&material_id=110
- Some of the "readings" will take the form of videos:
- Whole Systems Design Strategies, http://students-stg.autodesk.com/?nd=sustainable_strategy&course_id=1
- *Design for Product Lifetime*, http://students-stg.autodesk.com/?nd=sustainable_strategy&course_id=15
- Design for Disassembly & Recycling, http://students-stg.autodesk.com/?nd=sustainable_strategy&course_id=15
- Lightweighting, http://sustainabilityworkshop.autodesk.com/products/lightweighting
- Physical Properties of Materials, http://sustainabilityworkshop.autodesk.com/products/physical-properties-materials
- Design for Durability, http://sustainabilityworkshop.autodesk.com/products/durability

COURSE OBJECTIVES

The objective of this course is to provide students with the tools to frame, analyze, and redesign their projects in terms of life cycle environmental impacts, to improve the sustainability of their projects.

DESIRED COURSE OUTCOMES

Students can expect to depart the course understanding the practice of basic life cycle assessment, including how to set boundaries, choose functional units, and use LCA software. Students will also learn how to integrate this practice into new product development in the context of the "triple bottom line" – economy, environment and society. Students should be able to apply the skills mastered to real world design and engineering problems.

TOPICS COVERED

Week 1: Welcome, Review, & Priorities
Introduce yourselves, review the green design canon, and big-picture priorities for sustainability. Perform life cycle thinking activity.

Week 2: Frame Life Cycle Thinking
Define Life Cycle Thinking in engineering design. Review case studies.

Week 3: Exercise in Life Cycle Thinking
Learn boundaries and functional units. Perform a rough Life-Cycle Assessment (LCA) of an existing or theoretical product that is related to the students' design or research project.

Week 4: Prioritize the Problem and Rate Solutions
Redo LCAs based on feedback. Determine design / engineering priorities based on LCA results. Use a decision matrix.to weigh LCA priorities with social sustainability priorities and business priorities.

Weeks 5-6: Apply Life Cycle Tools to Design or Research Project
Frame and apply life cycle analysis tools to students' design or research projects. Perform sensitivity analyses.

Week 7: Final Presentation and Report
Students will be required to present a life cycle analysis of their project. They will also submit a plan for how to use life cycle thinking in future work.

CLASS/LABORATORY SCHEDULE

2 hours lecture per week for second half of Fall semester.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

The course focuses on analytical professional skills that are critical for successful sustainable product design and development in industry today.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

40% on homework assignments
20% on attendance and participation in class
40% on integration into research or capstone projects

REQUIRED SOFTWARE

SustainableMinds online life cycle assessment software-as-a-service. $49/six month subscription.

HOMEWORK ASSIGNMENTS

For each class session there will be a short individual assignment that students must complete before coming to class. These assignments allow students to experiment with some of the techniques being taught in the class and will be the basis for in-class exercises.

PERSON(S) WHO PREPARED THIS DESCRIPTION

Professor Agogino, April 29, 2013

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): LIFE CYCLE THINKING
TIE CODE: LECT
GRADING: Letter
SEMESTER OFFERED: Fall and Spring (second half)
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Agogino
DURATION OF COURSE: 1 units (2 hours of lecture per week for second half of Fall semester)
TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 6 hours (for second half of the Fall semester)
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: No