Sustainable Manufacturing, E290I, SP 2013

Tu/Th 9:30AM-11:00AM, 3113 Etcheverry

Instructors: M. Hutchins and D. Dornfeld
(margot.hutchins@berkeley.edu, dornfeld@berkeley.edu)

Course Description: Organizations are increasingly required to be sustainable and this call for sustainability extends into the realm of manufacturing. However, there is substantial ambiguity and differences in interpretation regarding what is meant by sustainable manufacturing. This course will provide the basis for understanding (1) what is envisioned as sustainable manufacturing and how that relates to larger issues such as global warming, energy independence, and human rights; (2) what comprises sustainable manufacturing practices in for-profit enterprises, (3) how to measure and track improvement toward sustainable manufacturing, (4) techniques and tools for product and manufacturing process design and development, and (5) effective communication of sustainability performance to internal and external audiences.

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 in small groups. Class projects will apply the analysis techniques covered in this course to design and develop sustainable products or processes or analyze policies that lead to more sustainable decision making. Interaction with industry and collection of real-world data will be encouraged.

Requirements: Graduate standing or consent of instructor; useful background: ME 290P: New Product Development: Design Theory and Methods; ME220: Precision Manufacturing; ME101: High Mix/Low Volume Manufacturing and ME122: Manufacturing Processes.

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

Instructors:
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.

Margot Hutchins, Ph.D. is a post-doctoral researcher in the Laboratory for Manufacturing and Sustainability at Berkeley and specializes in assessing social sustainability and sustainable manufacturing.

E290I Syllabus/Course Outline Spring 2013

Week	Date	Topic(s)	Project Milestones	Readings*
1	1/22	Course overview, (virtual) instructor introductions, student survey (YouTube video)		Ch. 1, pp. 1-23; Ch. 5, pp. 107-115.
1	1/24	Project Introduction; CO_2 Game		
2	1/29	Business Case for Sustainable Manufacturing – presentation and discussion		Ch. 2, pp. 25-47.
2	1/31	Business Case for Sustainable Manufacturing – **Outside Speaker: Elizabeth Sturken, EDF** and discussion		
3	2/5	Connecting Design Fundamentals to Sustainability		
3	2/7	Consumerizing Technology and Products: A paradigm shift from DfM to MFD – **Outside Speaker: Yoon Lee, Samsung**	Groups Finalized	
4	2/12	Connecting Design to Manufacturing		
4	2/14	Background on Manufacturing and Production (process to systems/supply chain)		Ch. 6, pp. 117-152.
5	2/19	Quality Engineering and Lean		Ch. 11, pp. 255-267.
5	2/21	Project Proposal Presentations (5 minute presentation/group)	Project Proposals Due	
6	2/26	Life-Cycle Thinking and Assessment (LCA Demos and Tools Comparison)		Ch. 3, pp. 49-81.
6	2/28	Manufacturing Impacts Beyond Manufacturing Phase (supply chain, consumer behavior)		
7	3/5	Overview of Energy in Manufacturing		Ch. 7, pp. 153-178; Ch. 9, pp. 203-221.
7	3/7	Energy Efficiency, Specific Energy and Political Implications – **Outside Speaker: Dave Lettieri**		
8	3/12	Managing Energy Use in Manufacturing Facilities and Processes – **Outside Speaker: Nancy Diaz**		
8	3/14	Overview of Material Use in Manufacturing	Draft Lit Review and Methodology Due	Ch. 8, pp. 179-202. Ch. 10, pp. 223-254.
9	3/19	Fundamentals of Materials Selection		
9	3/21	Group Project Discussions		
	3/26	Spring Break		
	3/28	Spring Break		
10	4/2	Green Chemistry & Environmental/Human Health: Design signals for Engineering – **Outside Speaker: Megan Schwarzman, School of Public Health**		
10	4/4	Overview of Water in Manufacturing		
11	4/9	Evaluating Water Intensity in Manufacturing		
11	4/11	Overview of Social Impacts of Manufacturing		
12	4/16	Identifying and Addressing Social Impacts		
12	4/18	Implementing Sustainability Initiatives in Organizations – **Outside Speaker Corinne Reich-Weiser, Enviance**		Ch. 4, pp. 83-105; Ch. 10, pp. 223-254

13	4/23	Sustainability Reporting, Standards, and Regulations – **Outside Speaker: Michael Kirschner, Design Chain Associates**		
13	4/25	Next Steps for Sustainable Manufacturing		Ch. 12, pp. 269-286.
14	4/30	Student Project Presentations		
14	5/2	Student Project Presentations		
15		RRR		
15		RRR	Reports Due	

Note: Bold dates indicate guest speaker(s)
* from ***Green Manufacturing – Fundamentals and Applications***

Instructors

Professor David Dornfeld — Department of Mechanical Engineering
6143 Etcheverry Hall
643-7013; dornfeld@berkeley.edu
Blog: http://green-manufacturing.blogspot.com/

Dr. Margot Hutchins — Laboratory for Manufacturing and Sustainability
1115 Etcheverry Hall
642-8657; margot.hutchins@berkeley.edu

Anton Sudradjat (GSI) — Laboratory for Manufacturing and Sustainability
1115 Etcheverry Hall
642-8657; asudradjat@berkeley.edu

Office Hours — W 10-11, R 2:30-3:30 in 1115 Etcheverry or by appointment

Text

D. Dornfeld (ed.), *Green Manufacturing: Fundamentals and Applications*, Springer, New York, 2013. (on-line through Springer e-books accessible to UC students through Kresge Engineering Library website).

Online text materials (download at not charge at the link provided):

- OECD, *Eco-Innovation in Industry: Enabling Green Growth*, OECD Publishing, 2010 (http://www.oecd-ilibrary.org/content/book/9789264077225-en)
- Julian M. Allwood and Jonathan M. Cullen, Sustainable Materials with Both Eyes Open, UIT Cambridge Ltd., 2012 (http://withbotheyesopen.com/)
- David J. C. MacKay, *Sustainable Energy – without the hot air*, UIT, Cambridge England, 2009 (http://www.withouthotair.com/download.html)
- Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, Little, Brown and Company, Boston, 1999 (http://www.natcap.org/sitepages/pid20.php)

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

Course Project

One major course project (typically groups of 3-4) will be required related to the course content and focus. The goals of the project are:

1. Demonstrate mastery of at least two core concepts from the course (e.g., a tool and sustainability concern)
2. Demonstrate teamwork, innovation, professional skills (oral and written presentation) at the graduate level
3. Address three pillars of sustainability from an engineering perspective
4. Demonstrate ability to identify a problem, propose a solution, and evaluate the feasibility of solution

Groups will be formed in collaboration with the instructors and announced at the end of Week 3 (2/7). A proposal for the group project will be submitted and presented for approval at the end of week 5 (2/21). A draft of two sections of the final report (literature review and methodology) will be submitted 3/14 and discussed with the instructors 3/21. Final Project presentations will be delivered in week 14 (4/30 and 5/2) and the final project report will be due 5/9.

Course project should, at minimum, include:

- justification of relevance to sustainable manufacturing or, at minimum, sustainable product design and manufacturing
- comprehensive literature review of relevant background material and other work in the same or similar area
- specific statement of objective and expected impact of the proposed project
- consideration of the triple bottom line: environmental, economic and social implications of the proposed system/product/process
- consideration of life cycle impacts of proposed system/product/process

Projects may be inspired by:

- Industry or corporate concern
- NGO or consumer concern
- Current research topic (for MS, PhD, capstone, etc.)
- Personal interest
- Entrepreneurial aspirations

Projects could be on one of the following general topic areas (NOT an exhaustive list!):

- Develop a system to measure sustainability
- Develop tools to support sustainable decision making
- Apply existing sustainability tools to specific processes, products or technology
- Design more sustainable processes, products, or technology
- Elements that may be included:
    - Life cycle thinking
    - Focus on improvements/issues in specific life cycle phase
    - Focus on specific products or industrial sectors
    - Comparison to existing or benchmark processes, products, or technology

- Case studies
- Development of hardware or software
- Commercial CAD packages
- Communication tools

Other project topics areas may be chosen in consultation with the Instructors and may be 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. You will need to demonstrate a specific unique contribution from this class for any project associated with another class. Novel format (video, YouTube format) presentations are also encouraged. You and your team may also develop "instructional" simulations or experiments for future E290I classes.

Homework, Exams and Grading

- Homework will be assigned and due the following week unless otherwise indicated. If an exception is required please contact the instructors.
- The grade will be determined on the following basis:
  - Homework/Small projects 50%
  - Final Project 40%
  - Class participation 10%

Academic Honesty

All students should be familiar with the Code of Student Conduct and know that the general rules and student rights stated in that document apply to this class (see http://uga.berkeley.edu/SAS/osc.htm and http://students.berkeley.edu/osl/sja.asp). Cheating on homework, projects or the final exam may result in a failing grade for the entire course. In all cases of alleged cheating, your actions will also be reported to the Office of Student Conduct for administrative review.