# ENGG*4070
# Life Cycle Technique for Sustainable Design

School of Engineering
University of Guelph
Winter 2013

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| **Instructor:** | Brajesh Dubey, Ph.D.THRN 1415; Ext. 52506, e-mail: bdubey@uoguelph.ca |
| **GTA:** | Eli Wasserman "Shawn", e-mail: ewasserm@uoguelph.ca (half GTA) |
| **Lecture Times:** | Monday and Wednesday @ 1:00PM - 2:20PM MACK 238 |
| **Lab:** | Friday @ 2:00PM - 03:50PM THRN 2313 |
| **Office Hours**: | As required (Open door policy), for an extensive consultations making appointment (e-mail or in person) is encouraged. TA does not have an office hour, meeting time for TA is during the lab sessions on Fridays, and he will also be available through e-mails and scheduled meetings. |
| **Texts:** | "Sustainable Engineering: Concepts, Design, and Case Studies" by David Allen and David Shonnard, Prentice Hall, ISBN-10: 0132756544, ISBN-13: 9780132756549<br><br>"Life Cycle Assessment: Principles and Practice", Downloadable from: http://www.epa.gov/nrmrl/std/lca/lca.html This EPA site contains numerous resource materials |
| **Other Readings** | Will be assigned and made available through the Course link course site throughout the semester. |
| **Exams:** | Midterm: Monday, Mar 11, 2013 in Class (1:00PM to 2:20PM) in MACK 238 |
| **Prerequisites:** | a) ENGG*2100 – Engineering and Design II<br>b) ENGG*3240 – Engineering Economics |

***COURSE SUMMARY***

This course will introduce students to the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society. Students will understand the concepts and the scientific method as it applies to a systems-based, transdisciplinary approach to sustainability, and will be prepared to identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues. The basic concepts of life cycle assessment (LCA) will be discussed, along with life cycle inventory (LCI) and life cycle impact assessment (LCIA) including the social and economic dimensions. The application of life cycle assessment methodology using appropriate case studies will be presented.

Students who successfully complete this course will:

- ✓ Understand multiple perspectives on the fundamental concepts in sustainability,
- ✓ Understand relationships among and limitations to disciplinary and transdisciplinary approaches to sustainability,
- ✓ Understand general LCA methodology and hands on experience in its application,
- ✓ Demonstrate use of SimaPro and associated databases to support an LCA study
- ✓ Appreciate the benefits and challenges associated with using LCA as a sustainability research tool

***GRADUATE ATTRIBUTES***

The Canadian Engineering Accreditation Board (CEAB) is moving towards an outcome based evaluation of engineering programs. Of the 12 CEAB graduate attributes, ENGG*4070 – Life Cycle Technique for Sustainable Design covers and assesses the following:

| Graduate Attribute | Covers | Assesses | Graduate Attributes | Covers | Assesses |
|---|---|---|---|---|---|
| Knowledge Base for Engineering | Y | Y | Communication Skill | N | Y |
| Problem Analysis | Y | Y | Professionalism | N | N |
| Investigation | Y | Y | Impact of Energy on Society & the Environment | Y | ? |
| Design | N | N | Ethics and Equality | Y | N |
| Use of Engineering Tools | Y | Y | Economics and Project Management | Y | Y |
| Individual and Team Work | Y | Y | Life Long Learning | Y | N |

***EVALUATION***

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| Individual Assignments | 25% |
| Group Assignment | 10% |
| Mid Term | 40% |
| Group Term Project | 25% |

***Individual Assignments***

Assignments will be issued on a regular basis to assist students in mastering the course content. The instructor will be available for assistance through e-mail and one to one in person meetings for any help needed. At least 2 week time will be available to complete a set of assignment.

***Group Assignment and Group Term Projects***

The students in this class will do a Group Term Project. The group project will be done in a group of 4 students. The same group will do the group term project together. The instructor will discuss the details of the group assignment and projects during the first class.

*Group Assignment*: In the group assignment, student group needs to identify a topic on which they do the term project. The term project needs to involve a LCA study using the software Simapro. The school of engineering has a class room license for this software. As part of the lab sessions on Fridays, GTA will work with the student on this software. The group assignment is due on Friday Feb 15th 2013. The students will submit group assignment (details will be provided) and will do a group presentation on this day. The presentation is brief 10 minutes followed by 5 minutes Q/A. The presentation will introduce the topic of group project, objective, approach/methods and expected results.

*Group Term Project*: Based on the topic selected, the student groups need to complete a LCA study using the software Simapro. As part of deliverables, a binder per group needs to be submitted. The binder will include a manuscript written on the topic following the guideline and format requirement for The International Journal for Life Cycle Assessment (http://www.springer.com/environment/journal/11367?hideChart=1#realtime). In addition to the manuscript, the binder will have all the background information collected on the topic, Details of Assumptions, Input and Output data from the software and any other relevant information as appropriate. The binder need to be submitted electronically to the instructor.

The due date for group term project is April 1, 2013. Group Presentations on projects will be on Apr-1 and Apr-3 and if needed on Apr-5. The presentations will be 25 minutes with 5 min Q/A, total 30 min per group.

***Mid-Term Exam***: Monday, Mar 11, 2013 in Class (1:00PM to 2:20PM) in MACK 238

The material covered will include the last lecture prior to the exam. The exam will be closed book. Permitted aids will be announced prior to midterm. Failure to attend the exam will lead to a zero for that exam unless valid documentation is provided for medical or compassionate grounds.

***TOPICS***

The following topics will be considered.

1. An Introduction to Sustainability (Introduction, The magnitude of sustainability challenge, Energy, Material use, Environmental emissions, Economic and Social dimensions)
2. Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Life Cycle Frameworks, Life Cycle Assessment Tools)
3. Life Cycle Analysis (Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools: SimaPro)
4. Review of Environmental Laws and Regulations (Introduction, Environmental Law and Sustainability, International Programs and Protocols relevant to this course, Voluntary Programs from end of pipe to Pollution Prevention and Sustainability, Pollution Prevention Concepts and Terminology)
5. Green, Sustainable Materials (Introduction, Environmental and Natural Resource Use Footprints of Material Extraction and Refining, Tracking Material Flows in Engineered Systems, Environmental Releases)
6. Design for Sustainability: Economic, Environmental, and Social Indicators (Introduction, Sustainable Engineering Design Principles, Economic Performance Indicators, Environmental Performance Indicators (LCA), Social Performance Indicators)
7. Case Studies (e.g., Biofuels for Transportation, Transportation Logistics and Supply Chain, Sustainable Built Environment etc.)

***CEAB AUs***

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| Complementary Studies | XX% |
| Engineering Science | 75% |
| Engineering Design | 25 % |

***University Policy on Academic Misconduct***:

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the undergraduate Calendar 2012-2013 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

***Disclaimer*:**

The instructor reserves the right to change any or all of the above as needed subject to the University of Guelph Academic Regulations.