

Materials 4I03/6I03
SEP 6I03

Sustainable Manufacturing Processes

Course Information 2016-2017

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Office hours: Fridays 10am-12pm, or by appointment

Lectures: Tuesdays, Thursdays, Fridays 2:30pm-3:20pm, T13/127

Prerequisite:

Registration in final or penultimate year of any Materials Engineering program or permission of instructor or registration in Level IV or above in other Engineering

Important Note:

The course management system will be Avenue to Learn and Top Hat. The student is required to check the system daily for assignment release/submission, course related material, and posted announcements. Go to the links below to find out how to log-on to the course's home page.

Course Website 1: www.avenue.mcmaster.ca

Course Website 2: www.tophat.com (course code: 454967)

Course Description:

Participants in the course will acquire an in-depth understanding of issues associated with sustainable manufacturing processes. During the term, the course will discuss the following topics: Sustainable development, materials cycles, methods for measuring environmental impact, life cycle analysis, waste treatment, recycling technologies, stakeholder concept and vision 2050. Readings include articles written by leading scholars in the field of sustainability. This course will be organized in weekly lectures and discussions.

Course Objectives:

By the end of this course students should be able to,

1. Define introductory and fundamental concepts of sustainability
2. Calculate personal ecological footprint.
3. Develop a life cycle analysis of an industry, a material or a process including compiling relevant data, calculation of material intensity (MI), energy intensity (EI), global warming potential (GWP) and acidification potential (AP).

4. Make a recommendation, including justification for the most “sustainable” method of processing that could be used to process or produce a given object or material, discussing the merits and drawbacks of the processing steps in terms of at least three of the most significant sustainability measures.
5. Be able to identify stakeholders in engineering activities related to economic, environmental and social factors, including a broad range of cultural and social backgrounds, both in Canada and abroad.

Course Overview and Assessment

Required Text: The custom courseware package is available at the McMaster Bookstore.

Assessment (Matls 4I03)

Individual Assignments:	20%
Team Project*:	40%
In-class test 1:	15%
In-class test 2:	20%
Participation:	5%
TOTAL	100%

*Students are to form teams of 4 people of their own choosing. Each student will submit 3 Peer Reviews. These reviews will rank and justify, if necessary, their own contributions, as well as those from each group member to determine what fraction of the total mark each member shall receive. Weighting will be applied to 100% of project mark.

Assessment (Matls 6I03 & SEP 6I03)

Individual Assignments:	20%
Team Project:	50%
In-class test 1:	10%
In-class test 2:	15%
Participation:	5%
TOTAL	100%

* Students are to form teams of 2 people of their own choosing. Each student will submit 3 Peer Reviews. These reviews will rank and justify, if necessary, their own contributions, as well as those from each group member to determine what fraction of the total mark each member shall receive. Weighting will be applied to 100% of project mark.

Individual Assignments (5% each):

The assignments must be submitted to the teaching assistant in tutorial. If there is no tutorial at that particular week, please submit your assignments to course dropbox, JHE-213 one week after they are assigned.

Project:

Prepare a 20-page (double-spaced, including Figures and Tables) report on sustainable manufacturing for an industry, process or product. Make a recommendation, with justification, of the most sustainable method(s), including at least three sustainability measures. The report must include an LCA that compares at least 2 competing process. The report must discuss the results, and include a sensitivity analysis for the appropriate aspects of the LCA.

Data for the LCA can be taken from the literature, but the calculation and the analysis must be done with the methodology described in the lectures. Commercial software may not be used for the calculation. The hard copy of LCA report must be submitted to the course dropbox, JHE-213 by 5pm on Dec 6.

In-class tests:

There will be two in-class tests throughout the term. They will deal with knowledge of sustainability issues, methodology and terminology.

Participation:

The class participation through the term including guest lectures using top hat application. However, each student will be permitted to miss up to three lectures and one guest lectures without a penalty.

Policy on Written Work and Late Submissions:

All written work will be marked on content and analysis as well as grammar, clarity of writing, and organization. More details about the marking scheme are posted on the course website. Late submissions will be penalized 20% per day. Late penalties will not be waived unless your Faculty/Program Office advises the instructor that you have submitted to that office the appropriate documentation to support your inability to submit the work by the due date.

Academic Integrity:

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, *e.g.* the submission of work that is not one's own or for which other credit has been obtained. Work of others must be referenced in the text by name or with superscripted numbers, and the reference information collected at the end of the report.
2. Improper collaboration in group work. Assignments must be done individually. The group projects are to be an equal collaboration by the students in the group.
3. Copying or using unauthorized aids in the examination.

Students will be required to submit their written report to electronically to ensure that the work has proper citation of previous work.

Academic Accommodation of Students with Disabilities:

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140, ext. 2865 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

Disclaimer:

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check his/her McMaster email and course websites weekly during the term and to note any changes.

Schedule of topics and required readings

Sep. 6, Introduction/Outline

Handout is posted on the website.

Sep. 8, Population & Environment

Living Planet Reports, 2014, 2012, 2010 & 2006 are available at the World Wildlife Fund website:

<http://www.worldwildlife.org/pages/living-planet-report-2014>

http://assets.worldwildlife.org/publications/333/files/original/Living_Planet_Report_2012_Biodiversity__biocapacity_and_better_choices.pdf?1345733116&_ga=1.190661739.1546495938.1441665340

Sep. 9, Ingenuity Gap

Homer-Dixon, T.

The Ingenuity Gap, Homer-Dixon, T.

Copyright (C) 2001 Vintage Books Canada

Ch. 1 "Careening into the Future"

Ch. 6 "Glimpsing the Abyss"

Ch. 7 "Unknown Unknowns"

Ch. 9 "Ingenuity and Wealth"

Sep. 13, The Materials Cycle

"Foundations of Sustainable Resource Processing"

Herbertson, J. & Sutton, P.

Green Processing Conference, Cairns, Qld, 29-31 May 2002

Copyright (C) 2002 Unsourceable

Global Materials Flows in Minerals Processing"

Algie, S.H.

Green Processing Conference, Cairns, Qld, 29-31 May 2002

Copyright (C) 2002 Unsourceable

Sep. 20, Eco-Efficiency (Part A)

DeSimone, L.D., et al.

Eco-Efficiency: The Business Link to Sustainable Development,

Copyright (C) 2000 ** MIT Press

Sep. 22, Eco-Efficiency (Part B)

DeSimone, L.D., et al.

Eco-Efficiency: The Business Link to Sustainable Development,

Copyright (C) 2000 ** MIT Press

Sep. 23, Environmental Impact Metrics (Part A)

"2012 The Outlook for Energy: A View to 2040", ExxonMobil

"Industrial Energy Intensity by Industry", Natural Resource Canada, 2004

"US Material Use factsheets", Center for Sustainable Systems, October 2014

"Greenhouse Gasses and Global Warming Potential Values except from the Inventory of U.S. greenhouse emissions and sinks", U.S. Environmental Protection Agency, 2002

"The global warming and the Greenhouse Effect", Copyright © 1998-2005 Lenntech Water treatment & air purification Holding B.V., Netherlands

Sep. 27 Environmental Impact Metrics (Part B)

Sep. 29, The Role of Materials in Sustainable Development

Norgate, T.E. & Rankin, W.J.
Green Processing Conference, Cairns, Qld, 29-31 May 2002
Copyright (C) 2002 Reprinted with permission

Sep. 30, Introduction to LCA

Environmental Assessment of products, Weidema B.P.
1997 TEK-Finnish Assoc. Grad. Eng
Chapter 1. Life Cycle Assessment in a Historical Perspective
Chapter 2. The Application area for Life Cycle Assessments
Chapter 3. Life Cycle Assessment in Relation to Other Tools
Chapter 4. Life Cycle Management
Chapter 5. LCA to Z- A beginners Guide

Oct. 4, Computational Structure of LCA I

Heijungs R. & Suh S, 2002, Luwer Academic Publishers
Ch. 2 Basic Model for Inventory Analysis

Oct. 6, Computational Structure of LCA II

Heijungs R. & Suh S, 2002, Luwer Academic Publishers
Ch. 3 The Refined Model for Inventory Analysis

Oct. 7, In class test 1

Oct. 10-14 – No class

Oct. 18, Computational Structure of LCA III

Heijungs R. & Suh S, 2002, Luwer Academic Publishers
Ch. 3 The Refined Model for Inventory Analysis

Oct. 20, Computational Structure of LCA IV

Heijungs R. & Suh S, 2002, Luwer Academic Publishers
Ch. 3 The Refined Model for Inventory Analysis

Oct. 21, Open Loop Recycling in LCA (Part A)

“The value of Recycling to Society and its Internalization into LCA methodology
J.P. Birat, La Revue de Metallurgie, 103, 2, 2006, Cambridge University Press US

Oct. 25, Open Loop Recycling in LCA (Part B)

“The value of Recycling to Society and its Internalization into LCA methodology
J.P. Birat, La Revue de Metallurgie, 103, 2, 2006, Cambridge University Press US

Oct. 27, LCA Case Study – Pb & Zn Production

"An Environmental Assessment of Lead and Zinc Production Processes"
Norgate, T.E. & Rankin, W.J.
Green Processing Conference, Cairns, Qld, 29-31 May 2002
Copyright (C) 2002 Unsourceable

Oct. 28, LCA Case Study II

Nov. 1, Stakeholders I

Stakeholder Politics, Social Capital, Sustainable Development and the Corporation, Robert Boutilier, 2009, Greenleaf Publishing, available in pdf format for ~\$45.00 from <http://www.greenleaf-publishing.com> or at Amazon for \$20

Nov. 3, Stakeholders II

Stakeholder Politics, Social Capital, Sustainable Development and the Corporation, Robert Boutilier, 2009, Greenleaf Publishing, available in pdf format for ~\$45.00 from <http://www.greenleaf-publishing.com> or at Amazon for \$20

Nov. 4, Strategic Sustainable Development

"Factor X for Subtle Policy Making"

Robert, K-H., et al

Greener Management International, Vol.31, Autumn 2000

Copyright (C) 2000 Greenleaf Publishing Ltd.

"Tools and Concepts for Sustainable Development, How Do They Relate..."

Robert, K.-H.

Journal of Cleaner Production, Vol.8, 2000

Copyright (C) 2000 Elsevier Science

Nov. 8, Vision 2050 I

Vision 2050 is available at <http://www.wbcsd.org/vision2050.aspx>

Nov 18, In-class test 2

Nov 9-Dec 2, Guest lecturers from Industry

Handouts are posted on the website. Depending in the availability of guest lecturers, there could be changes in the schedule.