Course Number	ARCH 680.1 L08	Classroom	HYBRID
Course Name	Life Cycle Assessment		
Pre/Co-Requisites	none		
Instructor	Dr. Getachew Assefa	**Office Hours/Location**	By appointment/Zoom
	Email: **gassefa@ucalgary.ca**	Phone: **403 616 1527 (cell)**	
Class Dates	Mandatory in-person and Zoom classes: Tuesday and Thursday 11:00am to 12:30pm. The scheduled time on Thursdays will be used for support regarding assignments. (see course schedule on Page 6 for further detail)		
Instructor Email Policy	Please note that all course communications must occur through your @ucalgary email, and I will respond to emails sent via student's @ucalgary emails within 48 hours.		
Name and Email of Teaching Assistant	TBD		

Course Description

Human activities are responsible for a number of environmental impacts at different levels. Many decisions made at the design stage determine impacts of the products, structures, services and business units that manifest during production, use and beyond. Assessment of such impacts can be best done using a life cycle perspective. The analytical tool of life cycle assessment (LCA) supports informed decision-making by avoiding problem-shifting and sub-optimization. When dealing with measures of improving environmental performance, problem-shifting occurs between life cycle stages e.g. upstream to downstream parts of the life cycle. It may also occur between medium such as shifting from air pollution to water pollution. Burden is also being shifted in space (e.g. from urban to rural) and in time (e.g. from today to the future). LCA provides an opportunity of, at least, minimizing such problem-shifting.

This course on LCA in design, offered for senior undergraduate and graduate students, helps would-be engineers, architects, designers and business professionals develop the skill of understanding the far-reaching and lasting implications of the decisions they make at different levels of product and service design and development.

This course explores theoretical background of LCA covering, among others, the following:

a) Methodological
  - Identification and delimitation of the system boundary
  - Defining and handling of allocation problems
  - Midpoint and endpoint approaches

b) Data
- Identification and use of data from LCA databases
- Collection and use of data from other sources

c) Results reporting and application
- Contents of an LCA report
- Analysis and interpretation of LCA results

The course delivery includes Lectures, LCA Review and Project
The lectures cover main topic areas of the course briefly outlined below.

Background to LCA
Reflecting on features of LCA including some brief history of LCA and different phases of LCA.

Goal and scope definition
The first phase of LCA includes aspects of system boundary, functional units, data quality requirements, etc.

Life cycle inventory analysis
Based on the information from the Goal and Scope Definition, quantitative dimension of LCA including data collection and modeling of the product or service system under consideration.

Life cycle impact assessment and Interpretations
The methods and approaches for quantifying the environmental impacts using the data collected; the implication of the choices involved in applying the different methods of aggregating data and weighting.

Data availability and quality in LCA
Data quality and associated issues will be outlined together with presentation of selected LCA software tools.

Product category rules and Environmental product declarations
Environmental product declarations as LCA -based labeling of products and services are the practical way of communicating the environmental performance through independently verified documents. How EPDs are developed based on product category rules will be explored and examples from different sectors will be provided.

Review:
Students will do a critical review of a life cycle assessment study. Full Review Assignment instruction is provided separately.

Project:
Students in groups will work on a life cycle assessment of a product of choice. They will submit a report of around 25 pages and make a final presentation. Full Project instruction is provided separately.

Online Delivery

Lecture videos will be posted on D2L for asynchronous learning. The live Zoom sessions during the timetabled periods as indicated in the course schedule will be used for question and answer, for exercises, discussing assignment and for follow up project progress. Students are required to review the lecture videos and do related readings and attend synchronous Zoom sessions. If unable to participate live due to unforeseen circumstances, inform the instructor in advance to work out an alternative participation activity.

Course Learning Outcomes

After completing the course, students should be able to:
1. Understand the overall purpose and principles of LCA.
2. Describe the content and explain the purpose of the different steps of LCA.
3. Carry out a complete LCA of a defined system based on the ISO standard for LCA.
4. Write an LCA report complying with guidelines and terminologies of the ISO standard.
5. Discuss possible applications and limitations of LCA.
6. Understand how a third-party critical review of LCA is done.

Learning Resources

Required readings, textbooks and learning materials:
Matthews, H. S., Hendrickson, C. T., & Matthews, D. H. (2015). Life cycle assessment: Quantitative approaches for decisions that matter. (e-book available for download for free at: https://www.lcatextbook.com/
For project, the free Life Cycle Assessment Software, OpenLCA (http://www.openlca.org) will be. **Students are expected to learn the software using online resources such manuals and YouTube videos from the vendor.**

Technology requirements: Reliable access to the following technology:
- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Broadband internet connection
.

Assessment Method	Description	Weight	Aligned Course Learning Outcome
Quizzes – 5 multiple choice quizzes (only 4 best will be considered)	Individual	20%	1-6
Critical Review	Group	20%	1-6
Project: Report and presentation	Group (report – 25, presentation file- 5, oral presentation 10)	40%	1-6
Test (open questions – whole course)	Individual	20%	1-6
Total		100%	

Grading Scale

Grade	Grade Point Value	4-Point Range	Percent	Description
A+	4.00	4.00	95-100	Outstanding - evaluated by instructor
A	4.00	3.85-4.00	90-94.99	Excellent - superior performance showing comprehensive understanding of the subject matter
A-	3.70	3.50-3.84	85-89.99	Very good performance
B+	3.30	3.15-3.49	80-84.99	Good performance
B	3.00	2.85-3.14	75-79.99	Satisfactory performance
B-	2.70	2.50-2.84	70-74.99	Minimum pass for students in the Faculty of Graduate Studies
C+	2.30	2.15-2.49	65-69.99	All final grades below B- are indicative of failure at the graduate level and cannot be counted toward Faculty of Graduate Studies course requirements.
C	2.00	1.85-2.14	60-64.99	
C-	1.70	1.50-1.84	55-59.99	
D+	1.30	1.15-1.49	50-54.99	
D	1.00	0.50-1.14	45-49.99	

F	0.00	0-0.49	0-44.99	

A student who receives a "C⁺" or lower in any one course will be required to withdraw regardless of their grade point average (GPA) unless the program recommends otherwise. If the program permits the student to retake a failed course, the second grade will replace the initial grade in the calculation of the GPA, and both grades will appear on the transcript.

CACB Student Performance Criteria

The following CACB Student Performance Criteria will be covered in this course at a secondary level.
A2: Research Skills
A4: Verbal and Writing Skills
A5: Collaborative Skills
B4: Sustainable Design

	Topic Areas & Detailed Class Schedule		
Date and time	Topic	Readings	Assignments/Due Dates
September 6	**L1- LCA Overview - online**		
September 8	Assignment session - online		
September 13	**L2- Goal and Scope Definition - in person**	Chapter 4	
September 15	**L3- Life Cycle Inventory - in person**	Chapter 5	
September 20	Assignment session - online		Quiz 1 focusing on L2
September 22	**L4- Data sources and issues - in person**	Chapter 5	Quiz 2 focusing on L3 Goal and Scope – milestone
September 27	*Assignment session – asynchronous*		
September 29	*Assignment session – asynchronous*		
October 4	No class / SAPL Block Week		
October 6	No class / SAPL Block Week		
October 11	*Assignment session – asynchronous*		
October 13	**L5- Life Cycle Impact Assessment - in person**	Chapter 10	Inventory – milestone
October 18	Assignment session – online		
October 20	Assignment session – online		
October 25	**L6- LCIA methods in OpenLCA - in person**	Chapter 10	
October 27	Assignment session - online		Quiz 3 focusing on L5
November 1	*Assignment session – asynchronous*		

November 3	*Assignment session – asynchronous*		
November 8 November 10	No class – term break No class – term break		
November 15	**L7- Interpretation - in person**		<mark>Calculated impact – milestone</mark>
November 17	**L8- LCA studies example - in person**		Review submission
November 22	Assignment session – online		
November 24	**L9- Product Category Rules and Environmental Product Declarations - in person**		Quiz 4 focusing on L7 <mark>Interpretation- milestone</mark>
November 29	Assignment session – online		Quiz 5 focusing on L9
December 1	Assignment session – Test – **in person (web-based)**		Need laptop for the Test
December 4			Project presentation file submission
December 6	Project presentation – in person		Project presentation
December 11			Project report submission

Guidelines for Zoom Sessions

Zoom is a video conferencing program that will allow us to meet at specific times for a "live" video conference, so that we can have the opportunity to meet each other virtually and discuss relevant course topics as a learning community.

To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor's permission.

The use of video conferencing programs relies on participants to act ethically, honestly and with integrity; and in accordance with the principles of fairness, good faith, and respect (as per the Code of Conduct). When entering Zoom or other video conferencing sessions (such as MS Teams), you play a role in helping create an effective, safe and respectful learning environment. Please be mindful of how your behaviour in these sessions may affect others. Participants are required to use names officially associated with their UCID (legal or preferred names listed in the Student Centre) when engaging in these activities.

Instructors/moderators can remove those whose names do not appear on class rosters. Non-compliance may be investigated under relevant University of Calgary conduct policies (e.g Student Non-Academic Misconduct Policy). If participants have difficulties complying with this requirement, they should email the instructor of the class explaining why, so the instructor may consider whether to grant an exception, and on what terms. For more information on how to get the most out of your zoom sessions visit: https://elearn.ucalgary.ca/guidelines-for-zoom/

If you are unable to attend a Zoom session, please contact your instructor in advance to arrange an alternative activity for the missed session (e.g., to review the recorded session). Please be prepared, as best as you are able, to join class in a quiet space that will allow you to be fully present and engaged in Zoom sessions. Students will be advised by their instructor when they are expected to turn on their webcam (for group work, presentations, etc.).

The instructor may record online Zoom class sessions for the purposes of supporting student learning in this class – such as making the recording available for review of the session or for students who miss a session. Students will be advised before the instructor initiates a recording of a Zoom session. These recordings will be used to support student learning only and will not be shared or used for any other purpose.

University of Calgary Policies and Supports

COVID-19 PROCEDURE FOR SICK STUDENTS: https://ucalgary.ca/risk/sites/default/files/Covid-19%20Folder/COVID-19-Procedure-for-Sick-Students.pdf

ACADEMIC ACCOMMODATION
It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to their instructor (contact information on first page above).
SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/ .

ACADEMIC MISCONDUCT

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

For information on the Student Academic Misconduct Policy and Procedure please visit:
https://ucalgary.ca/policies/files/policies/student-academic-misconduct-policy.pdf
https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf
Additional information is available on the Academic Integrity Website at https://ucalgary.ca/student-services/student-success/learning/academic-integrity.

COPYRIGHT LEGISLATION:
All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright.pdf) and requirements of the copyright act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy (https://www.ucalgary.ca/pubs/calendar/current/k.html).

INSTRUCTOR INTELLECTUAL PROPERTY
Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY
Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary.

SEXUAL VIOLENCE POLICY
The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf

UNIVERSITY STUDENT APPEALS OFFICE: If a student has a concern about the course, academic matter, or a grade that they have been assigned, they must first communicate this concern with the instructor. If the concern cannot be resolved with the instructor, the student can proceed with an academic appeal, which normally begins with the Faculty. https://www.ucalgary.ca/secretariat/student-appeals

OTHER IMPORTANT INFORMATION
Please visit the Registrar's website at:
https://www.ucalgary.ca/registrar/registration/course-outlines for additional important information on the following:
- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk