JEE 671 Life Cycle Assessment

(Course instructor: Prof. Dr. Shabbir H. Gheewala)

1. Course Description

The objective of this course is to introduce the students to the concept of life cycle thinking. The systems approach to dealing with environmental pollution problems is highlighted and Life Cycle Assessment (LCA) is introduced as an assessment tool. The course details are as follows. LCA: Introduction; methodology – goal, scope, inventory analysis, impact assessment; improvement analysis, such as identification of environmental "hotspots". Application of LCA to waste management and energy conversion systems, circular economy, product stewardship, and design for environment. The course is structured to have more emphasis on actual case studies, class assignments, and particularly important is a term project where the students are required to select a topic in the first few weeks of the beginning of the course and should follow the LCA methodology as it is discussed in the lectures. They are also given guidance on the term project all through the course so that they can learn the concepts discussed in the class by practical application to their individual topics.

2. Target Knowledge, Skills, and Abilities (KSA)

This course provides students with basic knowledge on life cycle assessment as a tool for environmental assessment. The students learn the principles, theory, and applications of life cycle assessment as well as get practical experience on conducting life cycle assessment for a specific case of their choice. They are also encouraged in life cycle thinking / systems thinking for any problem, not necessarily limited to environmental assessment.

3. Target group of students

The course is open to Master and PhD students with a general background in science or engineering. Non-degree students from academia, industry, and government are also welcome.

4. Pre-requisites

This course is designed as an introductory course and therefore there are no pre-requisites. A basic understanding of environmental issues is expected.

5. Course Learning Outcomes

CLO 1: Explain the overall purpose and principles of LCA.
CLO 2: Discuss benefits and challenges related to the application of life cycle assessment.
CLO 3: Describe the content and explain the purpose of the analytical steps of LCA.
CLO 4: Demonstrate understanding of the life cycle assessment methodology.
CLO 5: Demonstrate understanding of the resources required to do a life cycle assessment study.
CLO 6: Carry out a complete life cycle assessment study.

6. Method of Teaching and Learning

This course will be delivered in a hybrid format, i.e., a combination of online and on-site lectures and presentations. If students are in Thailand, an on-site format will be preferred as this is more effective for the class assignments which form a very important part of the course. Another very important part of the course is the term project which is conducted over the entire semester in parallel to the class lectures; the students receive personal guidance from the instructor. Once again, being on-site facilitates this as well. The online mode is accepted generally for students who are not in Thailand.

7. Course Outline and Organization

This course is opened every January semester. For the Semester 2/2025 (2568), this course is scheduled every Monday morning (9.00 am – 12.00 pm) from Monday 19 January 2025 onwards.

	Subject Outline	**Hours**
1.	Overview of LCA	3
2.	Goal and scope definition	3
3.	Scope definition (contd.)	3
4.	Allocation in LCA	3
5.	Allocation (contd.)	3
6.	Step-by-step exercise on LCA	3
7.	LCA exercise	3
8.	Impact assessment – midpoint methods	3
9.	Impact assessment – endpoint methods	3
10.	Application of LCA in strategic environmental assessment	3
11.	Application of LCA in waste management	3
12.	Application of LCA in assessing energy systems	3
13.	Carbon footprint	3
14.	Water footprint	3
15.	Special lecture	3
	Total	**45**

8. Evaluation Methods

Midterm exam: 30%
Final exam: 40%
Term project: 30%

Guided References/Resources

Textbooks

1. Life Cycle Assessment - A Guide to Best Practice (2014), Walter Kloepffer and Birgit Grahl, Wiley (ISBN: 9783527329861)
2. Life Cycle Assessment – Theory and Practice (2018), Springer (Editors: Michael Z. Hauschild, Ralph K. Rosenbaum, Stig Irving Olsen, ISBN 978-3-319-56475-3)
3. Environmental Life Cycle Assessment: Measuring the Environmental Performance of Products (2014) (Editors: Rita Schenck and Philip White, American Center for Life Cycle Assessment. ISBN: 978-0-9882145-3-8)
4. Baumann, H., and Tillman, A. (2004) The Hitch Hiker's guide to LCA: an orientation in life cycle assessment methodology and application. Studentlitteratur AB, Lund. ISBN 9144023642

Internet Resources

1. UNEP website: https://www.unenvironment.org/explore-topics/resource-efficiency/what-we-do/life-cycle-initiative
2. International Life Cycle Academy: https://ilca.es/
3. PRé: https://www.pre-sustainability.com/