The University of Texas at El Paso
Sustainability Engineering and Life Cycle Assessment
Fall 2018 – Course Syllabus

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Class meets (LART 206): Fridays 10:00 am – 12:50 pm

Office hours (A240): Mondays and Tuesdays 10:00 am – 11:30 am, and by appointment

Course web page:
https://blackboard.utep.edu/

Course Description:
This course in sustainability engineering and energy systems is interdisciplinary and covers design, manufacturing, supply and systems aspects of sustainability engineering. The class, will present the case for global sustainability, energy management, design for the environment, carbon footprint analysis and Life Cycle Assessment (LCA). LCA is a rigorous, quantitative approach to environmental impact evaluation that tallies the impacts of products throughout their lifetimes; it has been used successfully in a number of industries (particularly packaging and manufacturing) Moreover, this course will provide understanding of conventional and sustainable energy production and utilization that will serve as a foundation for Renewable Energy Systems and Natural Resources. In this course, different alternative energy sources available, including renewable energy (hydroelectric, solar, wind, biomass, and geothermal) will be reviewed. Each energy source's pros and cons based on our needs, availability, and environmental impact aspects will be discussed.

Prerequisites:
BE 3373 : Engineering Probability and Statistical Models (with a grade of "C" or better)

Course objectives:

- To provide a holistic systems approach to assess the environmental impacts for different systems
- To evaluate life cycle analyses of products and/or processes and propose strategies for addressing environmental impact while still meeting design and economic requirements.
- To propose design changes to a product to enhance recycling, reuse and/or remanufacturing capability with consideration of the economics of these activities.
- To learn about the energy situation and relevant economic and environmental issues;
- To understand the technical nature of energy and apply fundamental design concepts for efficient and renewable systems at both a community and site scale

Required textbook:
There is no required textbook, reading materials will be assigned during the semester

Useful references:

1. Curran M. A. (1996). Life Cycle Assessment: Principles and Practice. Scientific Applications International Corporation (SAIC). Environmental Protection Agency. Systems Analysis Branch. National Risk Management Research Laboratory. FREE- Link: http://www.epa.gov/nrmrl/std/lca/lca.html
2. Klöpffer W. and Grahl B. (2014). Life Cycle Assessment (LCA). Ed. Wiley.
3. Hendrickson C. T. (2006). Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach. Ed. Routledge
4. Vanek F. and Albright L. (2008). Energy Systems Engineering: Evaluation and Implementation. Ed. McGraw-Hill
5. Wengenmayr R. and Bührke T. (2008). Renewable Energy: Sustainable Energy Concepts for the Future. Ed. Wiley.
6. Tester J. W., Drake E. M., Driscoll M. J., Golay M. W. and Peters W. A. (2005). Sustainable Energy: Choosing Among Options. Ed. The MIT Press
7. Da Rosa A. D. (2009). Fundamentals of Renewable Energy Processes. Ed. Academic Press
8. Ristinen R. A. and Kraushaar J. P. (2005). Energy and the Environment. Ed. Wiley

Academic Honesty

It is expected that the students will conduct with integrity in all course areas. Do not attempt to engage in a dishonest activity such as copying, plagiarism, falsifying information, etc. The professor will take measures to prevent such instances and will bring a case to the university authorities. Information about University wide policies could be found in the Dean of Students Web page at http://studentaffairs.utep.edu/Default.aspx?alias=studentaffairs.utep.edu/dos

Grading

ITEM	Percentage
Project #1 report	15%
Project #1 presentation	10%
Journals critique and presentations	10%
Lab and Homework assignments	10%
Final project report	15%
Final Project Presentation	10%
Exam	30%

Software use:

A) EdGCM

In this course, you will learn about general climate change models (GCMs) and how climatologists use them to test hypotheses about the mechanisms governing past and potential future climates. We will use a model called EdGCM (Educational Global Climate Modelin), specifically designed for educational applications. EdGCM is based on a NASA climate model called GISS (for the Goddard Institute of Space Science). NASA- GISS was developed in the 1980's, and became famous because it was used to provide some of the earliest quantitative estimates of 20th-and 21st-century global warming. EdGCM's 'guts' are identical to this version of NASA-GISS but extensive visualization and analysis tools have been added. Personal computers are powerful enough now that runs that once required weeks of supercomputer time now can be completed in a day on a desktop PC or Mac. Through homework exercises you will learn how to use EdGCM and how to design climate model experiments. Then, working in teams of 3 students, you will design your own experiment, run EdGCM, prepare visualizations of key results, and present your work to the rest of the class.

B) Stella
STELLA (Systems Thinking, Experimental Learning Laboratory with Animation); is a visual programming language for System Dynamics Modeling (SDM) introduced by Barry Richmond in 1985. The program, is distributed by isee systems. STELLA is a flexible computer modeling package with an easy, intuitive interface that allows users to construct dynamic models that realistically simulate complex systems (Agriculture, Energy, Transportation, etc). Given the combination of ease of use and modeling power, the STELLA system is ideal to interface with research experiences. In its most basic form, modeling in STELLA proceeds in three steps: 1) constructing a qualitative model, 2) parameterizing it, and 3) exploring the model's dynamics.

C) GaBi®
GaBi stands for "Ganzheitliche Bilanz," which in German means Holistic Balance. GaBi® is considered one of the world-wide leading tools for Life Cycle Assessment. GaBi® is an user-friendly, powerful, and professional tool supporting users in sustainability life cycle data modeling, administration, and evaluation on the process, product, or organization level. GaBi serves for efficient completion of tasks such as

- Life Cycle Assessment (LCA) according to ISO 14040/44
- Life Cycle Engineering (LCE)
- Product and Process Optimization
- Design for Environment (DfE)
- Environmental Product Declarations (EPD)
- Sustainability Assessment – environmental / economic / social
- Life Cycle Costing (LCC)
- Energy and Resource Efficiency Analyses
- Greenhouse Gas Accounting
- Sustainability Benchmarking

D) HOMER® and GREET

HOMER is the global standard for optimizing microgrid design in all sectors, from village power and island utilities to grid-connected campuses and military bases. Originally developed at the National Renewable Energy Laboratory (NREL), and enhanced and distributed by HOMER Energy, HOMER (Hybrid Optimization Model for Multiple Energy Resources). It is a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation (DG) applications. HOMER models both conventional and renewable energy technologies

Project #1 Description

The purpose of the project 1 is to apply the concepts of LCA, the students must identify a particular system, product or process to be analyzed using GaBi®, for example,

- Present different designs of a particular product and evaluate its environmental impacts
- Environmental impacts of two existing similar products
- Perform a cradle-to gate analysis of a wind turbine, solar panel, etc.

Project #2 Description

The main objective for this project is for the students to have the possibility to explore additional topics related to energy systems and it connection to sustainability, for instance, the project may be based on a literature review related to a specific renewable energy system and or the presentation of alternative software to perform LCA or analysis related to renewable energy systems to the class, for example:

- Focus on a specific renewable energy source and present how the widespread implementation of the technology will help minimize the impact on the environment when compared with traditional "fossil fuel" technologies.
- The presentation of different material as a lab exercise of a different software tool to the class to perform LCA or energy systems analysis (software used must be free for the students to download), e.g., BEES, UMBERTO, etc

Students with disabilities:
If you have or suspect a disability and need accommodations you should contact Disabled Student Services Office (DSSO) at 747-5148 or at dss@utep.edu or come by Room 106 Union East Building.

Cell phone policy- In the past I have left it up to students to be courteous to the class and use their own discretion with cell phones and pagers. However, there are simply too many disturbances and distractions caused by a few cell phone abusers. Cell phones and pagers are to be off during class. You are not to take calls during class. I find that leaving and returning during class is very disturbing and rude. If you are in a group discussion it is especially rude. Exceptions would be emergency situations which you can notify me about before class.

Tentative Topics:

Item #	Topic
1	Class Syllabus and Introduction
2	Climate Change and climate modeling
3	Green Engineering Principles
4	Systems Tools, LCA– Goal and Scope Definition
5	LCA – Inventory Analysis
6	LCA – Impact Assessment
7	LCA – Interpretation
8	Renewable Energy Systems
9	Renewable Energy Systems - GREET
10	Systems Integration