

MECHENG 489 – Sustainable Engineering and Design

Course Mission

This course offers students the ability to understand the economic, environmental and social aspects of sustainability as they pertain to engineering design, as well as the ability to speak professionally about environmental and sustainability issues. Students also leave the class with the ability to perform streamlined life cycle assessments, EcoAudits, carbon/water/energy footprints, economic assessments, and mass and energy balances.

Learning Objectives

This course provides the fundamental tools and concepts of sustainable engineering, permitting students to analyze engineering projects from the perspective of the triple bottom line. The triple bottom line emphasizes social and environmental factors in addition to economic factors (the single bottom line). The course covers engineering decision-making, air and water pollutants, modeling of environmental pollutant concentrations, engineering economics, social considerations, pollution prevention, resource conservation, environmental life cycle assessment, human and eco-toxicity, life cycle costing, and energy systems. These concepts are applied in case studies covering the design of systems that minimize environmental impact considering local, regional, and global scales.

Why is this course an important course for engineers?

The world will change dramatically during the careers of engineers due to ecological constraints placed on the economic development of a large and growing human population. Already today, if everyone in the world lived at the U.S. standard of living, it would require roughly 6 Earths of resources. At current rates of population growth, we would require a new Earth worth of resources every 10-20 years to sustain the consumption rate of today. We exceeded the capacity for Earth to renewably support all humans living at a U.S. standard during the 1980s, which is before most undergraduates were born. Continuing down an economic growth path in ignorance of social and environmental constraints will lead to severe consequences, and as a result engineers of the future will need to become comfortable making technology decisions considering economic, environmental, and social dimensions simultaneously. This course is meant to prepare students to make future engineering decisions from the perspective of the triple bottom line.

Course Outcomes

After this course, a student:

1. Can use mass and energy balances to calculate the resource consumption and emissions caused by engineering systems.
2. Can identify common air and water pollutants and the concerns they raise for human health and the environment.
3. Can calculate energy efficiency and pollutant emissions released from combustion-based systems.
4. Understands how life cycle assessment and carbon/water footprint data can help in characterizing the environmental impact of different engineering systems.

5. Can calculate net present value and life cycle cost estimates for systems relevant to environmental impact.
6. Can identify the trade-offs among social, economic, and environmental drivers in engineering decision making.

Course Logistics

In this course students tour the major topics of sustainability assessment as it relates to engineering design including: footprinting, population growth, millennium development goals, life cycle assessment, air resources, water resources, toxicity and risk, energy resources, global warming, and sustainability economics. These are often presented in the context of short case studies. Although the course is largely quantitative, deep understanding of sustainability requires awareness of qualitative and descriptive topics. As a result, most topics start with an introduction where students will watch 20-60 minutes of video before class and take a short quiz on the topic. The Pre-class quizzes are due on the day indicated on the course schedule. Additional quizzes covering *in-class material* are also taken. The release dates are on the schedule with their due date being the second Sunday after the class they cover.

Lectures are recorded (available on CTools) for reference, convenience, and those who miss class. Please do not make a habit of missing class in favor of watching the in-class video sessions after they have occurred. If class attendance dips below 75% on a running average of 3 consecutive days, the on-line videos will be removed.

The class as a whole will discuss a policy for technology in the classroom.

ME 499 has a coursepack:

A coursepack is available for supplemental reading on technical concepts and for additional examples. It can be obtained from Dollar Bill Copying in electronic form, print form, or both.

<http://www.dollarbillcopying.com/CEE-265-ME-499-P1214.aspx>

Available for pick-up at 611 Church Street, Ann Arbor, 48104 / 734-665-9200

Call ahead or buy it on-line. Quantities will likely be short at the beginning of the term.

Office Hours (Professor Skerlos): <mailto:skerlos@umich.edu>

5pm-6pm Monday 3001F EECS Building

8pm-9pm Thursday (on-line)

Online Office Hours:

<https://bluejeans.com/866566676/7732?src=htmlEmail&g=onvwk4tmn5zua5l1nnfrwqltfmr2q====>

+1 888 240 2560 (US or Canada only) or +1 408 740 7256

Enter the Meeting ID: 866566676

Enter the Passcode: 7732

GSI Office Hours

Wednesday's 2:00pm-3:30pm and **Friday's** 1:30-3:00pm @ Mujo Cafe in the Dude

Course Grades

Exam 1 (20%)

Final Exam (20%)

Homework Assignments (20%)

Quizzes (20%)

Term Project (20%)

Attendance Policy

Attendance is expected at each lecture listed on the syllabus. Lecture will begin at 3:40pm, and entry after this time is discouraged as a courtesy to your classmates and lecturers. Consistently entering class late or leaving class early is irritating to everyone; so please refrain from this habit. While we do have a large class, we also expect that you will be engaged fully in the lectures. Please do not make a habit of missing class in favor of watching the in-class video sessions after they have occurred. If class attendance dips below 75% on a running average of 3 consecutive days, the on-line videos will be removed.

Email Policy

If you have a question or concern, please feel free to email the appropriate professor or the GSI. We may not be able to get back to you right away, but we will respond within 24 hours. Please begin the subject line with ME 499: followed by the subject of your email. Please refrain from sending assignment-related emails within 24 hours of the deadline.