

ME 4171 – Environmentally Conscious Design and Manufacture

- Instructor** Prof. Bert Bras. Telephone: (404) 894-9667
- Catalog Listing** Inclusion of environmental considerations in engineering design; reduction of environmental impact by design; recycling; material selection; demanufacturing and remanufacturing; life-cycle considerations and trade-offs.
- Credits** 3 credits. Lecture/discussion 3 hours per week.
- Prerequisites** Senior standing.
- Textbook** Selected chapters from:
- “Green Products by Design: Choices for a Cleaner Environment”, US Congress, Office of Technology Assessment, OTA-E-541, US Government Printing Office, Washington, D.C., October 1992.
- “Environmentally Benign Manufacturing”, International Technology Research Institute, World Technology (WTEC) Division, Panel Report, April 2001.
Both can be downloaded from the course website.
- Suppl. notes** Course notes and selected papers for reading are to be found on the Systems Realization Laboratory Web server under education and ME4171 (<http://www.srl.gatech.edu/education/ME4171/>).
- Objective** To provide Mechanical Engineering students and others interested in engineering design a view of how the environmental impact of engineering systems can be reduced by design.
- Outcome**
- The course is designed to give the students an opportunity to learn about environmentally conscious design and manufacture, the growing national and international efforts in reducing the environmental impact of products, and how the environmental considerations affect the design’s technical, economical and quality requirements.
 - The understanding of the students is fostered by means of various hands-on assignments.
 - The students should be able to use the knowledge gained in this course in practical design situations.
- Assessment**
- A grade is determined using the following means:
- Homework (45%)
 - Final exam regarding the material covered (25%), and
 - Major (group) project (30%). The students have to demonstrate the ability to apply the course material by designing an environmentally benign product and/or process.
- Assessment of the project assignments is based on the originality/difficulty of the problem undertaken, technical content, and quality of report and results.

Topics (subject to change and not necessarily in this order):

Motivation and examples of environmental impact

Product life cycles

Business drivers

- Regulations;
- Triple Bottom Line;
- ISO 14000 Environmental Management Standards

Environmental impact reduction approaches

- Environmentally conscious design and manufacturing approaches;
- Sustainable development and industrial ecology;
- Biomimicry and biologically inspired design

Measuring environmental loads and impacts

- Mass & energy balances;
- Material toxicity & MSDS;
- Indicators and metrics;
- Spatial & temporal boundaries

Manufacturing & Pollution Prevention

- EPA guidelines, regulations, and procedures;
- Toxic Release Inventory;
- Pollution prevention practices;

Recycling and Demanufacture

- Motivation (take-back legislation), concerns, definitions, examples;
- Recycling and demanufacture processes;
- Recyclability assessments;
- Design for Recycling practices, guidelines, methods, and tools;
- Trade-offs.

Life-Cycle Assessment (LCA)

- Motivation, definitions, approaches, examples;
- LCA methodology, steps, tools, problems;
- Life-Cycle Costing

Design for Environment

- Practices, guidelines, methods, and tools;
- Trade-offs.

Service, Reuse and Remanufacturing

- Motivation, issues, concerns, definitions, examples;
- Remanufacture processes (disassembly, inspection, cleaning, testing, and re-assembly);
- Remanufacturability assessments;
- Design for Remanufacture/Reuse practices, guidelines, methods, and tools;
- Lean remanufacture;
- Trade-offs.

Multi-scale modeling & design (examples)