

## SYLLABUS

### MECH 481A4: Green Engineering: Materials and Environment

#### Course Description

The scope of green engineering is broadly defined as minimizing environmental impacts across all life cycle phases in the design and engineering of products, processes, and systems. The detailed contents of green engineering can be various depending on one's discipline and perspective. This course will introduce the principles of green engineering with an emphasis in the context of materials since the design of anything essentially requires the use of materials. This course explores human dependence on materials and its environmental consequences and provides perspective, background, methods, and data for thinking about and designing with materials to minimize their environmental impact. Students will learn eco-attributes of materials and the relationship between materials engineering and environment. The course will combine regular lectures, case studies, open discussions and computer aided materials and processing selections to cover life cycle assessment, cost modeling, eco-selection and eco-design. Examples and case studies that illustrate environmental-impact-oriented design and relationship between design and green engineering will be discussed.

**Instructor:** Kaka Ma, Assistant Professor, Department of Mechanical Engineering

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**Lectures:** M/W/F 1-1:50 pm, online

**Credits:** 3

**Office hours:** M/W 2-3pm, online (Zoom or Microsoft Team), and by appointments as necessary. Appointments must be made through emails at least 48 hours in advance. Please address me as Dr. Ma in emails and other communications

**Textbook:** Michael F. Ashby, Materials and the Environment: *Eco-Informed Material Choice*, Second Edition, 2013

**Software:** Cambridge Engineering Selector (CES EduPack), Granta Design Limited, Cambridge, UK, 2019, [www.grantadesign.com](http://www.grantadesign.com), available in Glover 201 machines 13-20, with supporting documents and case-studies. Version 2016 is also available via Virtual Classroom. You can use your engineering eID to log into VCL to get access to CES software.

#### Reference Books:

- Michael F. Ashby, Materials Selection in Mechanical Design, 4th Edition.
- Donald R. Askeland and Wendelin J. Wright, The Science and Engineering of Materials, 7th edition; Cengage Learning

**Prerequisites:** Students taking this course are expected to have completed introduction to engineering materials MECH 331 and machine design MECH 325 or equivalent.

**Learning Objectives/Outcomes:** After completion of this course, a student is expected to:

- Understand the principles for green engineering
- Understand the life cycle of materials and be able to perform life cycle assessment of a product
- Use eco-attributes and materials property database to perform eco-selection of materials and processing to minimize environmental impact
- Be able to build cost models for eco-design
- Be able to guide design decisions that minimize or eliminate adverse eco-impact

**Tentative Weekly Lecture Topics:**

1. Introduction: principles of green engineering
2. Materials dependence
3. The material life cycle
4. Life cycle assessment: case studies
5. National and International Legislation
6. Eco-attributes of Materials
7. Introduction to CES software, midterm exam
8. Material selection strategies
9. Spring break
10. Eco-Audit and Eco-Audit Tools, Eco-informed material selection: case studies
11. Eco-informed material selection: case studies continued, Cost modeling
12. Sustainability
13. Project presentations
14. Materials for low-carbon power
15. Material efficiency
16. Design for the environment: vision for the future

**Grading:**

Homework Assignments      20%

Attendance and Participation   5%

Mid-Term exam                25%

One Design Project and Presentation 20%

Final Exam                30%

**Academic Honesty:** All students are required to adhere to the Policies and Guiding Principles (section 1.6 of the CSU general catalog) governing student conduct, and the Student Academic Integrity Policy.