Engineering Faculty Document No. 154-25
February 27, 2025

TO: The Faculty of the College of Engineering
FROM: The Division of Environmental and Ecological Engineering
SUBJECT: New Graduate Course, EEE 53700, Design for Sustainable Electronics

The Faculty of the Division of Environmental and Ecological Engineering has approved the following new course which will be cross-listed with MSE. This action is now submitted to the Engineering Faculty with a recommendation for approval.

EEE 53700: Design for Sustainable Electronics
Sem. 2, Lecture 2, Credits 3
Prerequisites: no
Instructor permission required for undergraduates

Course description:
During the course we will explore the following concepts for semiconductors and electronics:

- Integration of three pillars of sustainability: societal, environmental, and industrial/economic
- Material inputs (physical, chemical, energy) for manufacturing of semiconductors
- Product life cycle and life cycle assessment of Semiconductors
- Environmental impacts across life cycle
- Technical design inputs and constraints for net-zero semiconductors
- Economic analysis and the global supply chain
- Environment, Social, Governance (ESG), Corporate social responsibility (CSR) & sustainability
- Models for management of resources that support sustainability.
- Policy, supply chains, economy, and material sustainability
- Design for sustainability – ways different stakeholders look at electronics
- Communication across cultures, with different stakeholders, with peers
- Goal setting, leadership, assessment of programs, and personal learning

Reasons: Creating a new course and cross listing it with MSE.

John W. Sutherland, Professor and Fehsenfeld Family Head
Division of Environmental and Ecological Engineering

EEE 53700: Design for Sustainable Electronics
Level: Graduate

Course Instructor: John Howarter

Course Description
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Learning Outcomes & Learning Objectives
The ***planned outcomes*** for this course are to provide graduate students and senior undergraduates from a wide range of disciplines with:

- an introduction to the many dimensions of sustainability
- an opportunity to apply their disciplinary depth in developing ideas and proposals for solving open-ended, complex problems in sustainable electronics,
- the knowledge, skills, and abilities necessary to work effectively in highly interdisciplinary teams on real problems, particularly in sustainable electronics, and
- an understanding of the perspectives and needs of different stakeholders in global electronics.

Previous Teaching:
This course has been taught has both EEE 59500 and EEE 56000 for several years.

The syllabus for Spring 2025 follows.

Purdue University
Design for Sustainable Electronics

EEE 56000 (CRN 69792) **Spring 2025**
Lecture: Tuesday / Thursday–10:30 am-11:45 am (ET) in WALC 3121.
Faculty: John Howarter, ARMS 2213 or DUDL 2522

All meetings will be available hybrid both in WALC and on Zoom.
https://purdue-edu.zoom.us/j/4243970275?pwd=VEZvUWFZMnhoMnZzQTFsaTIzdUlXUT09
Meeting ID: 424 397 0275
Passcode: 634551

Overview of Design for Global Sustainability: The ***planned outcomes*** for this course are to provide graduate students and senior undergraduates from a wide range of disciplines with:

- an introduction to the many dimensions of sustainability
- an opportunity to apply their disciplinary depth in developing ideas and proposals for solving open-ended, complex problems in sustainable electronics,
- the knowledge, skills, and abilities necessary to work effectively in highly interdisciplinary teams on real problems, particularly in sustainable electronics, and
- an understanding of the perspectives and needs of different stakeholders in global electronics.

During the semester we will explore the following concepts for semiconductors and electronics:

1. Integration of three pillars of sustainability: societal, environmental, and industrial/economic
2. Material inputs (physical, chemical, energy) for manufacturing of semiconductors
3. Product life cycle and life cycle assessment of Semiconductors
4. Environmental impacts across life cycle
5. Technical design inputs and constraints for net-zero semiconductors
6. Economic analysis and the global supply chain
7. Environment, Social, Governance (ESG), Corporate social responsibility (CSR) & sustainability
8. Models for management of resources that support sustainability.
9. Policy, supply chains, economy, and material sustainability
10. Design for sustainability – ways different stakeholders look at electronics
11. Communication across cultures, with different stakeholders, with peers
12. Goal setting, leadership, assessment of programs, and personal learning

Grade Assignment:

25% Research Presentations
25% Research Proposal / Report
25% Class Participation / Attendance including external seminars
25% Homework

Grading scale will be a +/- scale with lower cutoffs as follows:
A:93 A-:90 B+:87 B:83 B-:80 C+:77 C:73 C-:70 D+:67 D:63 D-:60 F:0

Activities and Deliverables

Major Projects

Product Sustainability Report – students will perform a deep assessment of the sustainability of one class of (1) electronic material, (2) technology, or (3) product (laptops, cell phones, servers, printers, game systems, LCD TVs, automotive electronics, etc.). The students will assess its sustainability from multiple points of view using the life history approach developed in behavioral anthropology, the Ostrom framework, Polarity Management, and LCA/Supply Chain Analysis.

Research Innovation Report—students will identify one system (either manufacturing unit process, manufacturing sector, critical material, consumer product, etc) and propose a research program to address the technical challenges to material circularity and / or advancement toward carbon neutrality.

Class Participation: Attendance at all classes is expected, as is active class participation. Students should inform Prof. Howarter by email of absences and their reasons in a timely manner so that the student can work together for a positive solution to the student's absence.

Readings and Homework: There are numerous readings on topics from the course outline. Readings will be posted online (Brightspace). It is essential that students read all assignments before the class in which they are to be discussed and come to class prepared to discuss them in detail. Homework for each week will support the development of both understanding of the overall course topic and the team research projects. Turn in all assignments on BrightSpace, unless explicitly requested otherwise. Annotated bibliographies are assigned as part of the homework and are an integral part of the class. Use the annotated bibliography form provided for your submissions. General information on annotated bibliographies can be found at https://owl.english.purdue.edu/owl/resource/614/01/ or google (annotated bibliography Purdue). In contrast to what is at Purdue OWL, we are expecting more substantive summaries, analyses, and reflections in your annotated bibliographies.

The University Policy and Procedures Statements are on BrightSpace.