

TO: The Engineering Faculty
FROM: The Interdisciplinary Engineering Team
RE: New Engineering Degree
TITLE: Master of Science in Sustainability Engineering

DESCRIPTION:

The M.S./M.S.E in Sustainability Engineering degree will be a new degree offered in Interdisciplinary Engineering with majors in:

- *Sustainable Engineering*
- *Sustainable Building Design and Operation*

In addition to the new degree, the sustainability portfolio more broadly within Engineering will include Civil Engineering and incorporate opportunities for learners to take courses in one of the already established civil engineering tracks such as:

- *Sustainable Water*
- *Infrastructure, Resiliency, and Sustainability*

The Sustainability Engineering degree will provide students with the opportunity to engage in a wide range of interdisciplinary topics focused on integrating sustainability into engineering practices, challenges, and solutions. See detailed curriculum requirements on the following pages.

RATIONALE:

The master's and primary major in Sustainability Engineering will provide advanced technical education in industrial sectors of regional, national, and international importance. The need for this degree comes from discussions with the Purdue EEE External Advisory Council, other leading industrial professionals, and in consultation from faculty and leadership across Purdue College of Engineering and in collaborating units in College of Science, Agriculture, Business, and Purdue Online. We anticipate that a minimal number of new courses will be required to support this degree as many of the courses already exist within the Lyles School of Civil and Construction Engineering, School of Materials Engineering and Environmental and Ecological Engineering.

The major in Sustainable Building Design and Operation will provide education about the integration of different building systems and how to design for sustainability, indoor environmental quality, and energy efficiency. Including specialized courses about building energy modeling methods and tools, design of mechanical, electrical and envelope systems in accordance with new standards, smart building operation and controls, indoor environment assessment (thermal, lighting, acoustics and air quality), energy resources and grid interactions, as well as global sustainability engineering issues and systems thinking/design.

NEED FOR THE DEGREE:

Between 2017 and 2022 there was a 40% growth in occupations related to environmental engineering and technologies. Including architectural and engineering managers, environmental scientists and specialists, environmental engineers, natural science managers, conservation scientists, water and wastewater treatment plant and system operations and there were over 1.6 million total job postings Data provided by Purdue Online (Lightcast 2024).

This industry demand is being driven by concerns over operational impact, regulatory uncertainty, increased insurance, reputational damage and consumer preference. These concerns and more have fueled discussions with the Purdue EEE External Advisory Council, other leading industrial professionals, and in consultation from faculty and leadership across Purdue College of Engineering and in collaborating units in College of Science, Agriculture, Business, and Purdue Online. The need for expertise in sustainability engineering, with skills in energy transition, manufacturing, supply chain, modernized mobility, resiliency, adaptation and workforce development prove the need for a sustainability engineering degree that will provide students the opportunity to engage in a wide range of interdisciplinary topics focused on integrating sustainability into engineering practices, challenges and solutions.

COMPETITION:

While several institutions throughout the U.S. offer master’s degrees in sustainability few offer degrees in sustainable engineering. Of the [U.S. News and World Report 2024 Best Engineering Graduate Schools](#) (of which Purdue is ranked #6), only two offer online degrees in sustainable engineering, Stanford and the University of Wisconsin – Madison. The MS/MSE in sustainable engineering will allow Purdue to offer another high-demand, high-quality degree.

Tamara Kinzer-Ursem, Associate Dean for Graduate and Professional Education

Link to Curriculog (started not submitted): <https://purdue.curriculog.com/proposal:32764/form>

Purdue MS/E Sustainability Curriculum Requirements

Curriculum Requirements for Major in Sustainable Engineering

Total Credits needed: 30

- Two Core Courses:
 - EEE 530 – Life Cycle Assessment (3 Credits)
 - EEE 597/CE 597 – Global Sustainable Engineering (3 Credits)
- Third Core Course chosen from the following selection:
 - EEE55500 - Physico-Chemical Process in Environmental Engineering I
 - EEE55200 - Environmental Biotechnology
 - EEE54000 - Water Chemistry for Environmental and Ecological Engineering
 - EEE57000 - Solid and Hazardous Waste Management
- 9 credit hours of Technical Electives
- 12 elective credit hours in professional and applied courses

Curriculum Details

Required Core courses:

Course	Title	Term Offered	Credits
*ECE53000	Life Cycle Assessment	Spring	3
*ECE59700/CE59700	Global Sustainable Engineering		3

Required Third Core course from selection:

Course	Title	Term Offered	Credits
*EEE55000	Physico-Chemical Process in Environmental Engineering I	Spring	3
*EEE55200	Environmental Biotechnology	Spring	3
*EEE55400	Water Chemistry for Environmental and Ecological Engineering	Spring	3
*EEE57000	Solid and Hazardous Waste Management	Spring	3

*Will need development online

Technical Electives:

Course	Title	Term Offered	Credits
ABE59100/BME59500	Polymeric Biomaterials	Spring	3
BME50100	Biostatistics	Fall	3

BME56300	Quality Systems for Regulatory Compliance	Summer	3
BME56400	Ethical Engineering of Medical Tech	Spring	3
BME59500	Entrepreneurship in BME	Fall	3
CE50701	Geospatial Data Analytics	Fall	3
CE50801	Geographic Information Systems	Spring	3
CE54300	Coastal Engineering	Fall	3
CE54400	Subsurface Hydrology	Spring	3
CE54900	Computational Watershed Hydrology	Fall	3
CE55000	Physico/Chemical Processes in Environmental Engineering	Fall	3
CE56401	Data Science for Smart Cities	Spring, Fall	3
CE56601	Network Models for Connected and Autonomous Vehicles	Spring, Fall	3
CE56901	Smart Logistics	Fall	3
CE59700	Biological Wastewater Treatment	Every other Spring	3
CE59700	Design of Urban Water Infrastructure	Fall	3
CE59700	Design Principles and Practices of Drinking Water Systems	Spring	3
CE59700	Plastics in Infrastructure and the Environment	Summer	3
CE59700	Water Chemistry for Environmental and Ecological Engineering	Fall	3

CE65000	Photochemical Reactors: Theory, Methods & Applications	Spring	3
ECE50836	Intro to Data Mining	Fall	3
ECE51018/ME59700	Hybrid Electric Vehicles	Spring	3
ECE51216	Digital Systems Design Automation	Spring	3
ECE59500	Semiconductor Fundamentals	Spring	1
ECE59500/ME597000	Intro to Electronics Packaging and Heterogeneous Integration	Spring	3
IE53000	Quality Control	Fall	3
IE53300	Industrial Applications of Statistics	Spring	3
IE54500	Engineering Economic Analysis	Fall	3
IE54600	Economic Decisions in Engineering	Spring	3
IE57000	Manufacturing Process Engineering	Fall	3
IE59000	Design Lean Six Sigma Black Belt	Spring	3
MSE53000	Materials Processing in Manufacturing	Spring	3
MSE53500	Lean Manufacturing	Spring, Summer	3
MSE56800	Additive Manufacturing of Materials	Spring	3

Additional Professional and applied elective courses: Courses available in the Purdue Online catalog that provide additional training, expertise and practice in areas that are important to skill and professional development but that are not specific to one technical area. For example, project management, product development, technical writing, leadership development etc.

Curriculum Requirements for Major in Sustainable Building Design and Operation

Total Credits Needed: 30

- Five Core Courses (minimum)
- Three Required Technical Depth courses (minimum)
- Maximum of two optional elective courses

Curriculum Details

Required Courses (minimum of 5 courses required)

Course	Title	Credits
CE 51300	Lighting and Daylighting Design of Buildings	3
CE 59700***	Sustainable Building Design Construction and Operation	3
CE 51400*	Building Controls	3
CE 51500/ME 59700*	Building Energy Audits	3
CE 59700/ME 59700**	Building Energy and Performance Modeling	3
CE 59700/EEE 59500*	Indoor Air Quality	3
CE 59700*	BIM for High Performance Buildings	3

Required technical electives (minimum of 3 courses required)

Course	Title	Credits
ME 51300	Engineering Acoustics	3
ME 51800	Analysis of Thermal Systems	3
ME 59700	Distributed Energy Resources	3
CE 59700	Global Sustainable Engineering	3
CE52501	Built Environment Modeling	3
ME53900	Introduction to Scientific Machine Learning	3
ME50000	Advanced Thermodynamics	3

Optional technical electives (maximum of 2 courses allowed)

IE 57700	Human Factors in Engineering	3
GRAD 59000	Program Management: A Comprehensive Overview of the Discipline	3
SYS 51000	Tools and Methodologies for Designing Systems	3
SYS 53000	Practical Systems Thinking	3
CE56401	Data Science for Smart Cities	3
IE57800	Applied Ergonomics	3
STAT51100	Statistical Methods	3

*New course

**Under development

***The EFD for this class is being prepared- it's going to called "Modeling Smart Buildings"