ME 597: Distributed Energy Resources – Spring 2025

Tuesdays and Thursdays from 3 to 4:15 PM ET
Physics 201 and/or on Zoom
Instructor: Kevin J. Kircher, kevinjkircher.com

Image credit: DOE Loan Programs Office

Distributed energy resources (DERs) are controllable electrical devices that plug in at the edge of the power grid, typically through buildings. DERs – such as electric vehicles, heating and cooling equipment, energy storage systems, and rooftop solar photovoltaics – will play an increasingly important role in future energy systems that decarbonize, digitalize, and decentralize their operations. In this class, students will learn to model a variety of DERs, optimize DER designs, and control DERs to reduce costs, pollution, and impacts on the power grid. This class will involve a mix of coding and mathematical analysis. Students will do semester projects on current DER research and development topics.

Format: In-person and online

Grading: 20% homework, 30% take-home exam, 50% semester project

- Homework, the exam, and semester projects will involve some math and a lot of coding.
- Students can code in Matlab, Python, or Julia. The course staff will support Matlab and Python.
- Students may work together on homework, but each student must submit their own solutions.
- The TA will grade homework quickly on a three-tier scale (full, half, or zero credit) based on how much of the solution is present, clear, and correct.
- Each student gets one free three-day homework extension. No questions asked; just email the TA.
- For any other extensions, students must go through the Office of the Dean of Students.

- Each student will individually take a 24-hour take-home exam about halfway through the semester.
- Students can do projects individually or in teams of two or three.
- Each team will submit one final project report, written in LaTeX in a conference paper format.
- Each team will give two talks: One project idea pitch and one final project presentation. Both will be formatted like conference presentations, made in LaTeX using Beamer.
- Only one student from each team will present, but the whole team should help them prepare.
- Online students will join Zoom in real time for their teams' presentations.
- Each student will assess their own project contributions in a final meeting with me and their team. I will grade each team's project as a whole then adjust individual grades based on self-assessments.

Tentative schedule

- Introduction to energy, electricity, and DERs (2 classes)
- Modeling and simulation (~9 classes)
- Project pitches (~2 classes)
- Optimization (~5 classes)
- Optimal control (~2 classes)
- Supervised learning (~2 classes)
- Facility tours (~2 classes)
- Final project presentations (~4 classes)

Prerequisites

- Required: Linear algebra, ordinary differential equations, and facility with programming in a language such as Matlab, Python, or Julia.
- Not required, but may enhance appreciation: Optimization, control systems, probability, statistics, machine learning.

Textbook: None

Websites

- Kevin's website will host lectures slides and videos, homework assignments, etc.
- Students will upload assignments to Gradescope.
- Students can discuss with each other and the TA on Slack.

Contact information and office hours

- Kevin Kircher (professor; kkirche at purdue dot edu): TBD in HLAB 1022 and at https://purdue-edu.zoom.us/my/kjkircher.
- Nadah Al Theeb (TA; naltheeb at purdue dot edu): Mondays from 9 to 11 AM ET and Tuesdays from 11:30 to 1:30 PM ET in HLAB 2067 and at https://purdue-edu.zoom.us/j/7231659253.