

ECE 285 – Data Science and AI for Smart Grids (SHI)

This new interdisciplinary graduate course bridges power systems and modern AI and data science. Students will learn both the fundamentals of power systems, as well as advanced AI techniques, with a focus in the Winter 2026 offering on how Agentic AI and Large Language Models (LLMs) can transform the operation, optimization, and control of future smart grids.

Covered Topics

- Basics of Power Systems
- Smart Grid Architectures
- Demand Response and Load Flexibility
- Renewable Power and Integration
- Distributed Energy Resources and Microgrid
- Energy Economics and Market Operations
- Grid Frequency and Voltage Control

Data Science and AI Topics (Winter 2026 Focus: ★Agentic AI and LLM)

Explore cutting-edge research in Agentic AI and Large Language Models (LLMs). Students will present and discuss recent papers, architectures, and emerging applications of AI for smart grid modeling, control, and optimization.

- LLM Fundamentals – Transformers & Tokens
- LLM Fundamentals II – Scaling Laws & Pre-training
- Prompt Engineering, Embeddings & Retrieval-Augmented Generation (RAG)
- Fine-tuning & Alignment
- Agents I — Planning, Tool Use & API Calling
- Agents II — Memory, Reflection & Evaluation

Project-Focused Learning

Students will work in teams to develop an agentic AI solution for one of the smart grid topic areas. While datasets will be provided, teams are expected to independently obtain, configure, and manage their own computing resources to support project development. Teams will submit a final report and deliver a live demo showcasing their project outcomes.

Prerequisites:

- ECE 175A or an equivalent fundamental machine learning course
- Familiar with Python Coding
- Optional but preferred: ECE 121A Power System Analysis and Fundamental

Instructors:

Prof. Yuanyuan Shi, Email: yyshi@ucsd.edu

Daniela Rojas, Email: d2rojas@ucsd.edu

***Seats are limited to 30 for WIN'26 due to the hands-on project-based nature of the course.**

