Three Essentials of the Electric Grid: Engineering Essentials (ENV 5510)

Tuesday, May 31-June 3, 2022, 9am-12pm (In person format)

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Overview: This course provides an introduction to the electric grid: its main components, architecture, operation and fundamental limitations. The goal is to introduce students to the key characteristics of this complex technical system and to develop an understanding of how electricity is generated, distributed and consumed. The physics of the electricity will be discussed and how the laws of physics can dictate what the electrical grid can and cannot do. There will be a discussion of the history of the grid and its evolution into what the US has today. The course will also include information on the evolution of the power grid into a “Smart Grid” including technology and design changes taking place in the industry today.

The homework assignments will include reading, qualitative short paragraphs as well as quantitative problem-solving. No advanced math skills are assumed or required. A take home final will be given. The homework will account for 40% of the grade. The final exam will count for 50% with the remaining 10% of the final grade based on class participation.
Tentative Schedule:

Tuesday, May 31
Introduction to electricity
Basic Physics
Volts, Amps and Watts
Power versus Energy
Direct and Alternating Current
Generators and Loads
Energy Storage

Wednesday, June 1
Three phase power
Transmission and Distribution lines
What is reactive power?
Transformers
Substations
Line losses and their importance
Protection Systems

Thursday, June 2
Grid Operation: balancing supply and demand
Monitoring of the Power System
Outage Planning

Computer modelling of power systems

Role of the Independent System Operator (ISO)

Inertia and Power System Stability

The big bad blackout - The Texas story.

Friday, June 3

Security Issues in the Power System

Smart Grid

Microgrids

Interactions of the gas and electric systems

Deregulated generation and the power system

Solar, Wind and storage generation

Integration of the renewables into the power system

Take Home Final - Due Tuesday, June 7th at 6 PM