



EECS 498 Special Topic

Grid Integration of Renewable Energy Sources

Wednesday 3:30-5:30pm and Friday 9:00-11:00am

The course will consider large-scale integration of renewable generation in electricity grids, with a focus on wind and solar (photovoltaic and thermal) technologies. Impacts of generation variability on grid operation and control will be addressed. Both local (voltage) and grid-wide (frequency regulation) effects will be considered, and methods for analysing these phenomena will be developed. Wind and solar forecasting will be reviewed. Approaches to accounting for renewable uncertainty in optimal generation dispatch will be evaluated. The course will explore the use of energy storage and load control for offsetting variability. The design and operation of renewable-based microgrid energy systems will also be investigated.

Syllabus:

1. Power systems: basic concepts, system operation.
2. Wind and solar resources: characteristics, variability, forecasting.
3. Wind power: principles of wind energy extraction, electromechanical energy conversion, characteristics of wind turbines, voltage regulation.
4. Photovoltaic (PV) cells: energy conversion principles, electrical modelling, optimal power extraction, shading.
5. Solar thermal: operating principles, storage capability.
6. Energy storage: technologies, operating strategies, degradation.
7. Grid operation and control: voltage control, frequency regulation, optimal generation dispatch, dynamics of low inertia systems.
8. Design of renewable energy systems using HOMER.

Prerequisites: EECS 215 or 314 or permission of instructor or graduate standing.

Credits: 4 hours.

Instructor: Prof Ian Hiskens, EECS, <hiskens@umich.edu>.