

This class deals with the Dynamics, Control, and Operations of Electric Power Systems. The perspective is that of the relationships between load and generation; transmission details are referred to when needed but are not a primary aspect of the discussion. Practical aspects of power system operation and the analytical processes used in modeling the power system will be woven together throughout the class. The following are among the topics to be addressed, not necessarily in the order listed here:

Basic aspects of dynamic simulation of large power systems

- Technique and economics of computation
- Network solutions
- Stability of numerical integration
- Selection of state variables

Fundamentals of stability / control system design

- Control system elements - physical aspects - hydraulic/electrical/mechanical
  - mathematical aspects
- Design of feedback loops (in power plant context)

Characteristics of power system elements

- Synchronous machines - synchronizing and damping torques
  - characteristic reactances
  - operational issues - operating limits - protection
  - generator controls
- Induction machines - electrical details - driven loads
- Reactive power control elements
- Real power control/energy storage elements

Characteristics of power system loads

- Traditional load representations
- Evolving load properties - air conditioning
  - electronic motor drives - constant / adjustable speed

Power plant characteristics

- Steam plants - turbine dynamics - boiler configurations, dynamics, controls
- Gas turbines - control fundamentals
  - operational limits, constraints - emission controls
- Combined cycle plants - configuration - operation - dynamic characteristics
- Hydro plants - dynamic characteristics - operational aspects
- Renewable resource plants - wind - solar
- Electronic coupling of generation to the grid

Power system control

- Primary and secondary control concepts
- Scope and scale of control - time scale - geographic scale - voltage level scale

Control of interconnected power systems

- Control of frequency
- Control of real power flows
  - net interchange control
  - frequency bias

Equipment testing and data management

- Test techniques
- Collection and validation of modeling data
- Validation of simulation results