EEL 6935

Smart Grid: A Cyber Physical Systems Approach

Instructor: Pramod P. Khargonekar

Course Summary: This course is aimed at first or second year graduate students in electrical/computer engineering, computer science, mechanical engineering, industrial and systems engineering, and mathematics/economics. In particular, students with research interests in energy systems, control systems, communications, signal processing, computer networks, security, and optimization may benefit from taking this course. Undergraduate background in power systems is useful but not required. The main goal of the course is to expose students to emerging research topics under the broad theme of smart grid. We will leverage the fundamental principles of cyber physical systems – communications, computation, and control – as a unifying theme to think about these emerging research opportunities. It is hoped that the students can then deeply explore one of these research directions in their future research.

List of Potential Topics and Outline:

1. Introduction to Smart Grid: Vision, goals, societal issues, technological drivers.
2. Power Systems Operations: Background in power systems operations: stability, control, optimization, and economics.
3. New power systems elements: renewable generation, storage, electric vehicles.
4. Smart grid enablers: sensors, communications, networks, computation, control.
5. Wide area monitoring, protection, and control (PMU and its applications)
6. EMS (Energy Management Systems) and SCADA
7. Distribution automation and optimization: volt/VAR control, FDIR, Demand-side management
8. Power balancing under uncertainty
9. Renewable generation and integration [solar and wind]
10. Energy markets – a cyber-physical system perspective
11. Storage optimization
12. Distributed coordination and control: responsive loads, energy efficiency
13. Cyber-security issues in smart grid
14. Connections to sustainability and economic growth