EL 6653 Power System Stability
Francisco de Leon

Thursdays from 6:00 to 8:40 PM
September to December 2010

Official Program

- EL 6653 Power System Stability

Description:
Introduction to the study of power system dynamics: mathematical modeling of prime movers, power plants, synchronous machines, field exciters, transmission lines, relays, loads and stabilizers
Program

- Introduction to Power System Stability
  - Definitions
  - Importance
  - Types of instabilities
- Synchronous Machine
  - Physical description
  - Mathematical description
  - Parameters
- System Modeling
  - Transmission systems
  - Loads
  - Excitation systems
  - Primer movers

Program (Cont’d)

- System Stability
  - Steady state stability
  - Small-signal stability
  - Transient stability
  - Voltage stability
  - Subsynchronous oscillations
  - Mid-term and long-term stability
  - Improving stability

Technical Objectives

- At the end of the course the students should be able to assess the stability behavior of a large interconnected power system
- Gain understanding on the dynamic performance of a power system
- Propose remedial actions when a problem is encountered

Pre-requisites

- Graduate status
- **EL 5613 - Introduction to Electric Power Systems**
  - Basic concepts: single and three-phase circuits, power triangle; transmission lines parameters: resistance, inductance, capacitance, transformers, and generators; lumped-component pi-equivalent circuit representation; per-unit normalization; symmetrical phase components; load-flow program.
- **EE 3064 - Feedback Control**
  - Introduction to analysis and design of linear feedback control systems. Modeling of physical systems, performance specifications, sensitivity and steady-state error, Routh-Hurwitz and Nyquist Stability tests. The use of Root Locus and frequency-response techniques to analyze system performance, and design compensation (lead/lag and PID controllers) to meet performance specifications.
Pre-requisites

- **Power system steady state**
  - Modelling of components
  - Load-flow (power flow)

- **Dynamic systems**

\[ \frac{dx}{dt} = Ax + Bu \]
\[ y = Cx + Du \]

- **Numerical methods**
  - Numerical integration
  - Solution of systems of linear equations \( Ax = b \)
  - Solution of systems of nonlinear equations \( g(x) = 0 \)

- Can you solve an electric circuit in steady state?
- What do you do if the loads are not characterized as impedances, but as constant loads \( S = P + jQ \)?

Calendar

- **First Session:** September 9, 2010
- **Classes**
  - 9/9, 9/16, 9/23, 9/30
  - 10/7, 10/14, 10/21
- **Mid-term:** 10/28
- **Classes**
  - 11/4, 11/11, 11/18, 11/23 (Tuesday)
  - 12/2, 12/9
- **Final/Projects:** December 16, 2010
### Course Evaluation and Details

#### Evaluation
- Weekly assignments: 10%
- Mid-term: 30%
- Project/Final: 60%

#### Consulting
- Thursdays 5-6 in Room LS 255 (before class)
- Phone: (718) 260 3961