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

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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

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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

Text (Required): Kundur, P., "Power System Stability and Control", McGraw-Hill, 1994.

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Technical Objectives

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

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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.

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Pre-requisites

- **Power system steady state**
  - **Modelling of components**
  - **Load-flow (power flow)**
- **Dynamic systems** $\longrightarrow$ $\frac{d}{dt}x = A\,x + B\,u$, $y = C\,x + D\,u$
- **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*)?**

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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**

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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**

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