

Analyzing the Power Grid

PMP EE 559

- Instructor:** Prof. Miguel A. Ortega-Vazquez, maov@uw.edu
- Class:** Mondays 1800-2150 hrs. at EEB 045
- Office hours:** Sundays 1500-1630 hours at M350, EE building.
- TA:** To be announced
- Course text:** Glover, Sarma & Overbye, *Power Systems Analysis and Design*, 5th Edition, 2012.
- Purpose of the course:** The purpose of this course is to equip the students with the basic understanding of power system's components; as well as the methods to analyze electrical power systems.

Course Syllabus:

1. Introduction ~3 hours
 - 1.1. Electric systems
 - 1.2. A bit of history of electric power systems
 - 1.3. The structure of the US power system
2. Power systems basics ~3 hours
 - 2.1. The phasor transformation
 - 2.2. Instantaneous power
 - 2.3. Complex power
 - 2.4. Reactive power compensation
 - 2.5. Three-phase systems
 - 2.6. Operation of three phase systems
3. Transmission lines ~6 hours
 - 3.1. Elements of a Transmission line
 - 3.2. Transmission line differential equations
 - 3.3. Lossless transmission line
 - 3.4. Lumped parameters model (π -equivalent)

- 4. Transformers ~6 hours
 - 4.1. Transformers overview
 - 4.2. Ideal transformer
 - 4.3. Real transformer
 - 4.4. Per Unit calculations
 - 4.5. Per unit calculation in three-phase systems
 - 4.6. Change of base
 - 4.7. Three-phase transformers
- 5. Synchronous Generators ~3 hours
 - 5.1. Structure of a synchronous generator
 - 5.2. Model of a synchronous generator
 - 5.3. Operation of an isolated synchronous generator
 - 5.4. Operation of a synchronized generator
- 6. Power Flow ~9 hours
 - 6.1. Linear vs. non-linear systems
 - 6.2. Review of nodal analysis
 - 6.3. Admittance [\mathbf{Y}] matrix
 - 6.4. Power flow equations and type of buses
 - 6.5. Review of the Newton-Raphson method
 - 6.6. Application of the Newton-Raphson method to solve the power flow problem
 - 6.7. dc power flow
 - 6.8. Power flow applications and controls
- 7. Fault analysis ~6 hours
 - 7.1. Balanced Faults
 - 7.2. Symmetrical components
 - 7.3. Unbalanced faults