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**Text:** J. D. Glover and M. S. Sarma, “Power Systems Analysis and Design,” PWS Publishing Co. Boston, 1999.

**References:** J. Grainger, W. D. Stevenson, Power System Analysis, 5th Ed. McGraw-Hill, 1994  
 A. R. Bergen, V. Vittal, Power Systems Analysis, Prentice Hall, 2000

### Calendar

Week	Lecture T&R	Topic	Lab/F	Lab Topic	Read Sections
1	3/29; 3/31R	Fundamentals of Power Systems	4/31	Lecture	Chapter 2
2*	4/5, 4/7Q	Symmetrical Components	4/7*	Quiz/Lecture	Chap. 8
3	4/12R; 4/14	Power Transformers	4/14	<b>Lab I</b> – Symm. Components	Chap. 3.1-3.2
4*	4/19; 4/21Q	Power Transformers Per Unit Calculations	4/21	Lecture/R	Chap. 3.4 Chap. 3.3
5	4/26; 4/28	Summary/Review Transmission Line Parameters	<b>4/28</b>	<b>Mid-Term</b>	Chap. 4
6	5/3; 5/5R	Transmission Line Parameters Transmission Line Operation (short, medium & long models)	5/5	Lecture/Rec.	Chap. 4 Chap. 5.1-5.3
7*	5/10; 5/12Q	Transmission Line Operation Loadability and Compensation Normal Conditions - Power Flow Studies	5/12	<b>Lab II</b> – Transmission Lines	Chap. 5.4-5.7 Chap. 6.4, 6.1
8	5/17; 5/19	Iterative Methods – Gauss	5/19	Recitation	Chap. 6.2, 6.5
9*	5/23; 5/26Q	Iterative Methods		<b>Lab III</b> Power World	Chap. 6.5
10	5/31, 6/2	Fault Conditions Review	6/2	<b>Lab IV</b> – Demo Fault Experiments	Chap. 9
11*	TBA	<b>FINAL</b>			

\* Denotes quiz week: please see course policy

R: denotes planned recitation; Q: denotes planned quiz

## Objectives

It is the objective of this class to provide a technical introduction to fundamental models, computational tools and power system hardware for analysis, simulation and experimentation of power system steady state behavior. This type of model is used in state-of-the-art power system operating software of modern power system control centers. A *tentative* field trip to PECO Energy's Control Center will illustrate how the taught concepts and models are used for industrial power system operation.

The course is designed in compliance with the ECE21 paradigms. In addition to technical content you will learn to perform hardware experiments and use industrial power system simulation software. Theoretical topics will be illustrated using worked examples in class as well as homework assignments. Computer simulation and experimental verification will be performed in the lab assignments:

- Homeworks are *individual* assignments (**15%**)
- Laboratories may be performed as *team work* (**20%**)
- Quizzes, mid-term and final exam will assess individual performances (**65%**)

## Road Map

In this course we will perform the following tasks:

1. Model generators as a voltage source with internal impedance
2. Model balanced operating conditions including faults
  - 2.1. Define balanced 3-phase systems
  - 2.2. Model balanced 3-phase systems as single phase systems
3. Develop steady state power system component models for steady state analysis including
  - 3.1. Transformers
  - 3.2. Transmission lines
    - 3.2.1. Measure transmission line data
    - 3.2.2. Calculate transmission line data
    - 3.2.3. Compare results
  - 3.3. Simple load model
4. Assembly components to form a power system
  - 4.1. Establish power system data set
  - 4.2. Specify load data
  - 4.3. Specify generation data
  - 4.4. Specify component data
5. Establish a steady state system model called load flow or power flow model
  - 5.1. Understand the numeric algorithms used for solving the power flow equations
    - 5.1.1. Measure power flow data
    - 5.1.2. Simulate the power system load flow using professional software
    - 5.1.3. Compare results
    - 5.1.4. Plan and design an upgrade for a power system to alleviate current operating problems.

## Course Policy:

1. The course is presented in a lecture/ recitation / lab format. It is very important that you attend all scheduled class meetings. If illness or other problems prevent attendance, be sure to check with the instructor and other students without delay to obtain material missed.
2. A 15-25 minute quiz will be given on the days marked with an asterisk (except if announced otherwise).
3. **All exams and quizzes will be closed book.** Make-ups will not be given at the request of the student, however they will be considered if and only if the student notifies the instructor in advance and has valid excuse. Otherwise, grades for the missed exam or quiz will be zero.
4. Homework assignments will be given weekly and the solutions will be distributed in class. The homework will be collected on Thursdays and graded. Each homework problem will be assigned 10 points.

**Grading policy:**

The course grade will be mainly based on the numerical score calculated using the percentages shown below for the midterm, homework, recitation quizzes, computer program, and final exam.

Homework	15%
Labs	20%
Quizzes	15%
Midterm	20%
Final	30%

**Excerpt from the Drexel University Student Handbook on Academic Honesty:**

“When a student is suspected of violating academic honesty standards, the faculty member will, as soon as reasonably possible, notify the student of the suspected infraction, seek the student’s explanation, undertake any further investigation the faculty member considers appropriate, and initially determine whether a violation of the academic honesty policy has occurred. If the faculty member concludes that a violation has occurred, he or she will inform the head of the department offering the course of the alleged violation. If, based on the evidence presented by the faculty member and the results of any further investigation the department head may decide to undertake, the department head agrees that an academic honesty infraction has occurred, the department head and faculty member will determine the appropriate sanctions and inform the student of their decision.

If an act of academic dishonesty is determined to have occurred, for a first offense, one of the following sanctions will be imposed, depending on the gravity of the offense:

- reduction of a course grade,
- an "F" for the assignment or exam, or
- failure for the entire course with the inability to withdraw.

The decision of the faculty member and the department head shall be reported to the Office of Judicial Affairs, which is responsible for maintaining student conduct records and the incident will result in an official disciplinary record for the student(s).”