

Baylor University
Department of Electrical and Computer Engineering
Course Syllabus

ELC 4340/5396 - Power Systems
Fall 2022

Course description – Analysis of power systems, including energy sources, transmission lines, power flow, transformers, transmission and distribution systems, synchronous generators, stability, power system controls, short-circuit faults, and system protection.

Prerequisite: ELC 3335 or equivalent

Textbook: *Power System Analysis and Design*, by Glover, Sarma and Overbye, - 6th ed. Cengage Learning, 2017: https://www.amazon.com/System-Analysis-Activate-Learning-Engineering/dp/1305632133/ref=sr_1_1?s=books&ie=UTF8&qid=1471807332&sr=1-1&keywords=Power+System+Analysis+and+Design%2C+Sixth+Edition

References: *Power System Analysis and Design*, by Glover, Sarma and Overbye, - 4th ed. Thompson, 2008, & 5th ed. Cengage Learning, 2012.
First Course on Power Systems, by Ned Mohan, 2006 Edition, MINPERE.
Elements of Power System Analysis, by Stevenson, McGraw-Hill, 1982.
Power System Analysis, by Bergen and Vittal, 2nd ed., Prentice-Hall, 2000.

Course goals and objectives: The goal of the course is to introduce the basic components of electric power system and analysis tools. By the end of the semester, students are expected to have learned and should be able to do the followings:

- Three-phase circuit analysis
- Transformer modeling and per-unit analysis
- Transmission-line modeling
- Power flow analysis
- Symmetric fault analysis
- System protection
- Power systems control
- Power system stability

Course Outline:

<u>Topics</u>	<u>Chapters</u>
1. Basic Principles: phasors, complex power, network equations, balanced three-phase circuits, complex power transmission	2
2. Transformer Modeling and the Per Unit System: single-phase transformer model, per-unit system, three-phase transformer, regulating transformers	3

“The fear of the Lord is the beginning of wisdom, and knowledge of the Holy One is understanding.” (Proverbs 9:10)

3. Transmission-Line Modeling: terminal representations, simplified models, power transmission, power handling capability, reactive compensation	5
4. Power Flow Analysis: power flow equations, the power flow problem, Gauss-Seidel iterations, Newton-Raphson iteration, decoupled power flow	6
5. Symmetrical Faults: generator modeling, transient phenomena, three-phase short circuit, bus impedance matrix, circuit breaker and fuse selection	7
6. Symmetrical Components: sequence networks, per-unit sequence models, power in sequence networks	8
7. Unsymmetrical Faults: single line-to-ground fault, line-to-line fault, double line-to-ground fault, sequence bus impedance matrices	9
8. System Protection: overcurrent relays, radial systems, directional relays, impedance relays, differential protection, zone protection	10
9. Power System Stability: the swing equation, simplified machine model, equal-area criterion, multimachine stability	11
10. Power System Controls: generator-voltage control, turbine-governor control, load-frequency control, economic dispatch, optimal power flow	12

Specific Additional Requirements for Graduate Students:

Additional computer projects will be assigned for the requirement in the degree program. Typical projects are:

- Transmission line modeling using PSCAD-EMTDC
- Power Flow using MATLAB and *PowerWorld*
- Power Quality using PSCAD-EMTDC
- Synchronous Generators and AVR using PSCAD-EMTDC
- Voltage Regulation using *PowerWorld*
- Transient Stability using MATLAB
- AGC using SIMULINK, and Economic Dispatch using *PowerWorld*

Course requirements:

Grading policy:

Homeworks & Projects	30%
Quizzes	10%
Exams (2)	40%
Final Exam	20%
TOTAL	100%

- Exams are in closed-books; calculators are not to be shared during the exam, and phones are not to be used during the exam; turn off the phone and secure in a bag/packpack.

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- Quizzes will be given normally in the beginning of classes to test some basics to be covered in the lecture.

Website: <http://web.ecs.baylor.edu/faculty/lee/>

- Students are expected to check the website on a daily basis for announcement, handouts, homeworks, and solutions to HW's and Exams.

Reading Materials:

- Lecture notes will be posted in the web. Read the notes prior coming to the class and be prepared to take a quiz and participate in discussions.

Homework Policies:

- There will be approximately ten assignments for the semester.
- No late homework will be accepted unless approved in advance.
- Homework assignments will typically consist of three to five problems. Solutions to the problems will be made available in the webpage.
- Students may informally discuss the homework problems and approaches to the solutions. However, exact written solutions should not be shared. Each student must independently prepare his or her own solutions. Copying or sharing solutions will result in zero credit for both parties and a report to the academic department and the university honor council (see <http://www.baylor.edu/honorcode>).

Computer Simulation:

- *PowerWorld* Simulator (provided with the text) will be primarily used for selected problems and computer projects, and the use of MATLAB will be also encouraged.

FE (Fundamentals of Engineering Examination)

- The Fundamentals of Engineering (FE) exam is typically the first step in the process leading to the P.E. license. It is designed for recent graduates and students who are close to finishing an undergraduate engineering degree. The FE is a computer-based exam that is administered year-round in testing windows at NCEES-approved Pearson VUE test centers.
- Students who are planning to work in power and energy industry are encouraged to take the FE examination during their senior year. Details of the examination dates, deadlines, and online registration can be found in the web: <http://www.statusin.org/7899.html>

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