ECE 319 Fundamental of Power Engineering

Credits: 4, **Contact Hours:** Two 75 minute lecture sessions per week, one 160 minute laboratory session per week.

Coordinator: M. Krishnamurthy, Associate Professor of ECE

Textbook: S. J. Chapman, *Electric Machinery and Power System Fundamentals*, McGraw-Hill, 2002.

2019 Catalog Data: ECE 319: Fundamentals of Power Engineering. Credit 4. Principles of electromechanical energy conversion. Fundamentals of the operation of transformers, synchronous machines, induction machines, and fractional horsepower machines. Introduction to power network models and per-unit calculations. Symmetrical three-phase faults. Gauss-Siedel load flow. Lossless economic dispatch. Laboratory considers operation, analysis, and performance of motors and generators. The laboratory experiments also involve use of PC-based interactive graphical software for load flow, economic dispatch, and fault analysis. Lecture: 3 Lab: 3 Credits: 4 Satisfies: Communications (C)

Prerequisites or co-requisites by topic: Entering freshman status

Enrollment: Required course for EE majors

Specific outcomes of instruction:

After completing this course, the student should be able to do the following:

1. Analyze balanced three phase circuits in the steady state
2. Use the per unit system in power circuit analysis
3. Explain the basic electromagnetic and electromechanical principles underlying the operation of transformers and rotating electric machines.
4. Develop the equivalent circuits for transformers (single phase and three phase) and AC machines (synchronous and induction). Use these equivalent circuits to analyze transformer and machine performance.
5. Perform tests to determine the equivalent circuit parameters for transformers and rotating machines.
6. Explain the electrical characteristics of transmission lines, develop equivalent circuit models of transmission lines, and use the models for analyzing line performance.
7. Represent power systems by one-line diagrams and by per-phase equivalent circuit models for steady state power flow analysis. Solve the resulting power flow equations iteratively with a computer.
8. Calculate balanced three phase faults on power systems.
9. Prepare an informative and organized lab report that describes the methodologies employed, the results obtained, and the conclusions made in a laboratory experiment.

Relationship of ECE 319 specific outcomes of instruction to student outcomes:

	Student Outcomes	**Course Goals**
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1,2,3,4,5,6,7,8, 9
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	4,5,6
3	An ability to communicate effectively with a range of audiences	9
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	9
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	9
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Topics:

- Introduction, Electromagnetic and Circuit Fundamentals (1 week)
- Three Phase Circuits (1 week)
- Transformers (1.5 weeks)
- AC Machinery Fundamentals (1 week)
- Synchronous Generators (1 week)
- Synchronous Motors (1 week)
- Induction Motors (1 weeks)
- Transmission Lines (1.5 weeks)
- Power System Representation & Equations (1 week)
- Introduction to Power Flow Studies (1 week)
- Symmetrical Faults (1 week)
- Tests and Final Exam (1 week)

Laboratory topics:

- Photovoltaic Arrays and Fuel Cells (1 week)
- Introduction to MATLAB and Circuit Analysis (1 week)
- Workbench Orientation (1 week)
- Introduction to PowerWorld and Power Factor Correction (1 week)
- Transformers (1 week)
- Synchronous Generators (1 week)
- Synchronous Motors (1 week)
- Induction Motors (1 week)
- Three-phase Transmission Lines (1 week)
- Power Flow and Symmetrical Fault Studies on a 5-Bus System (1 week)
- Multi-area System Operation Studies Optimal Power Flow (1 week)

Prepared by: I. Brown **Date:** February 26, 2020