COLORADO SCHOOL OF MINES
ELECTRICAL ENGINEERING & COMPUTER SCIENCE DEPARTMENT

EENG 481: ANALYSIS AND DESIGN OF ADVANCED ENERGY SYSTEMS
SPRING 2017

Instructor Information:

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Office Hours:
MWF: 11:00 - 11:50 am
Tuesdays: 1:00 – 2:50 pm

Lecture: MW: 1:00 – 1:50 PM, BB 302
Laboratory: F: 1:00 – 3:50 PM, BB 316A

Course Description:

The course investigates the analysis, operation and design of complex interconnected electric power grids, the backbone of the electric power infrastructure. Evaluating the system operation, planning for the future expansion under deregulation and restructuring, ensuring system reliability, maintaining security, and developing systems that are safe to operate has become increasingly more difficult. Because of the complexity of the problems encountered, analysis and design procedures rely on the use of sophisticated power system simulation computer programs. Consequently, this class will focus on the design and application of power system analysis software. The PowerWorld Simulator software will be used. Advanced power system analysis and design can be accomplished using this simulation program.

The lecture portion of the course is designed to present, discuss, and demonstrate examples of the course material, while the lab portion will give the students experience in solving open ended design problems for each of the major topics covered in the course. Colorado School of Mines is in close proximity to a number of large and small electric utilities, government research labs and process industries so the weekly laboratory session will also be used to permit a number of practicing professionals to present relevant information throughout the semester. Tours have been planned to an energy management center, a regional utility substation, the Western Area Power Administration's Electric Power Training Center and an energy marketing facility.

Prerequisite:

EENG 480 or consent of instructor

Required Textbook:

Power System Analysis and Design, by J. Duncan Glover, Thomas J. Overbye, and Mulukutla S. Sarma, Sixth Edition, Cengage Learning, Stamford, Connecticut, ©2016, ISBN 13: 9781305632134.

Blackboard:

A site on Blackboard will be maintained for this class. The course instructors will use the Blackboard site to deliver information to the students.

Course Objectives:

The objectives for the major focus areas of the course are listed below:

1. **Power Flow Studies:** The emphasis will be on determining how the power flow within a large system is controlled and understanding the factors that influence voltage regulation and reactive power control. Other key aspects of power flow studies involve contingency analysis, evaluating system improvements, and planning for future expansion.
    a. Students will be able to describe the power flow problem formulated as a set of nonlinear algebraic equations which are most suitable for a computer solution, and will be able to explain and perform the Jacobi, Gauss-Seidel and Newton-Raphson methods of analysis.
    b. Students will demonstrate proficiency in the use of PowerWorld Simulator software, create power system models and apply the models to analyze power system operations.
    c. Students will be able to evaluate an existing power system and perform a contingency analysis to understand the vulnerability of the network. System planning is an important aspect of power system analysis and design. Power system design is an open-ended process so students will be able to evaluate alternatives and justify their design decisions.
    d. Students will have the opportunity to work with experienced planning engineers to see industrial applications of transmission and power system planning software.

2. **Short Circuit Studies:** Short circuit currents resulting from symmetrical and unsymmetrical faults will be determined and the coordination of protective equipment will be explored.
    a. Students will be able to use the PowerWorld Simulator to calculate the short circuit currents resulting from symmetrical and unsymmetrical faults in a system and will be able to use the results from a fault study to select power system protective equipment.

Grading:

Homework Assignments & Tour Summaries	20%
Power Flow Studies Project 1: 20% Project 2: 10% Final Project: 20%	50%
Short Circuit Studies	15%
Quizzes, Class Participation, and Attendance	15%
Total	**100%**
The standard grading scale (shown below) will be used for this course: A: 90-100; B: 80-89; C: 70-79; D: 60- 69; F: below 60	

Colorado School of Mines Academic Dishonesty Policy:

The policy on homework is that it is perfectly acceptable for groups to work on the homework together. However, all students must turn in individual homework (unless otherwise stated) and they must understand what they turn in. Copying of solutions without understanding them is not allowed; if a student copies a solution and cannot explain it adequately this is considered academic dishonesty. For computer exercises each student is expected to generate his/her own solution (i.e. one cannot simply copy another person's computer solution and modify it slightly to make it look like it is your own work).

For laboratories, again students can work in groups but must understand all aspects of the laboratory. Representation of calculated data (i.e. dry lab) as measurements is considered academic dishonesty.