

## EE5806 Substation Engineering Design

University of Colorado at Denver and Health Sciences Center  
College of Engineering and Applied Science

Term Fall 2009

Course dates/days/times Friday 5:30PM-8:00PM

Course location CN 205

Office Hours After Class

Professor Keith Malmedal Ph.D. P.E. P.Eng

Office location CN 205

Phone 303-935-4303

email address keithmalmedal@msn.com

### Course Design

*Catalog Description:* Covers important topics relating to the application of engineering principles to the design of transmission and distribution substations and switching stations. Topics to be covered physical design, equipment ratings and selection, grounding, lightning protection, insulation coordination, bus systems reactive compensation and protection. Prereq: graduate standing or consent of instructor.

#### *Instructor Description:*

This course will discuss the major topics, problems, and solutions a practicing engineer may encounter when designing substations or switching stations from 35kV to 765kV. It considers how engineering principals must be applied to design a system that is reliable, maintainable, and safe. It will discuss air insulated installations, but gas insulation installations will also be briefly discussed.

#### *Course Objectives:*

A student completing this class should understand the engineering concepts relating to the designing substations. The student should be able to size equipment, physically design a substation, and design the lightning and grounding systems in the substation. They should understand the types of substations that may be needed, when special types of substations should be considered and understand all stages of design from planning to detailed design.

### Requirements

*Required Texts:* Electric Power Substations Engineering 2<sup>nd</sup> ed.  
John D. McDonald  
CRC Press  
ISBN 0-8493-7383-2

Design Guide for Rural Substations  
Rural Utility Service Bulletin 1724E-300  
Issued 2001  
Available for free download at  
<http://www.usda.gov/rus/electric/pubs/1724e300/1724e300.pdf>

#### *Recommended Texts:*

Various IEEE standards will be used and must be procured by the student.

#### *Additional, Materials, Equipment:*

#### *Assignments and Examinations:*

Assignments – Homework will be assigned weekly  
Final Project - One project with presentation will be required.  
Examinations – Three In-Class examinations will be assigned

## Assessment Design

### Grades:

Graded work is normally returned in-class the week following it's due date.

There are 1000 points possible in this class. Homework will vary in value with complexity but will be approximately 400 points total and exams are 200 points each.  $A > 899$  points,  $899 \geq B > 750$  points,  $750 \geq C > 650$  points,  $650 \geq D > 500$  points,  $500 \geq F$ . Scale is absolute and no grades are dropped. Late work is accepted only if previous notice is given.

Course Policies: Cheating and plagiarism will not be tolerated and any student engaging in either will receive a failing grade for any applicable work. Dates shown on the syllabus are tentative and may vary as needed. Late work is accepted only with prior arrangement, or in case of illness or emergency. When pre-arranged, missing homework may be made up and turned at a later date arranged. Exams may be made up in the case of illness or emergency as soon after the originally scheduled date as possible. If not pre-arranged, late homework may be turned in but credit given will be at the discretion of the instructor. Each homework assignment may be turned in only once and must be complete at the time it is turned in. Illness or absences may be reported via e-mail. No homework or other work will be accepted via e-mail unless previously arranged. No homework or other material is accepted by being deposited in my in-box unless pre-arranged. All work must be turned in personally during normal class hours.

### Class Schedule

Date	Topic	Required Reading	Assignments
August 21	Basic design considerations	RUS 1-4, TX 1-3	Homework 1
August 28	Power system calculations review		Homework 2
September 4	Fault current calculations		Homework 3
September 11	Power Transformers	RUS 5, TX 4,8	
September 18	<b>Exam 1</b>		
September 25	Power Circuit Breakers	RUS 5, TX 4	Homework 4
October 2	Bus design	IEEE Std.	Homework 5
October 9	Major equipment design	RUS 5, 10,13,17 TX4, 6, 7	Homework 6
October 16	Site Design and physical layout	RUS 6, 16 TX 9, 10, 13	Homework 7
October 23	Grounding design	RUS 9, TX 11, IEEE 80	
October 30	<b>Exam 2</b>		
November 6	Lightning protection design, insulation coordination	RUS 4, TX 12, IEEE std.	Homework 8
November 13	Protective Relaying	RUS 12, TX 6	Homework 9
November 20	Capacitor bank design	RUS 5, TX 4, IEEE Std.,	Homework 10
November 27	<b>No Class Fall Break</b>		
December 4	DC System. Final Projects Due	RUS 15,	
December 11	<b>Exam 3</b>		

### Course Communication

- Office hours are after class.
- The use of e-mail for questions and other correspondence is highly encouraged. I may be phoned at my home number any evening before 11PM.

### Students called for military duty

- If you are a student in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact Paul Rakowski.