ELECTRICAL ENGINEERING 4PL4
ENERGY SYSTEM AND MANAGEMENT - FALL 2009
Course Outlines

(3 Lectures, 1 tutorial, 3-hr. Lab. Every other week)

Instructor: Dr. N. Al-Mutawaly; almutan@mcmaster.ca

Teaching Assistant: TBD

CALENDAR:
Elements of generation, transmission, and distribution systems; system-wide energy flow and control; modeling and simulation; economics and management; fault prediction and management.

PREREQUISITE: ELEC ENG 3PI4

COURSE OBJECTIVE:

To develop computer based models for energy systems. To develop financial models for energy conversion and transmission. To use these models in a computer based power flow program to assess performance and control real and reactive energy flows and voltage levels under steady state and fault conditions. To make energy systems management decisions based on engineering and financial data.

POLICY REMINDER:

"**Academic dishonesty"** consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.

2. Improper collaboration in group work.

3. Copying or using unauthorized aids in tests and examinations."

"The Faculty of Engineering is concerned with ensuring **an environment that is free of all adverse discrimination**. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.

"The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes."

COURSE LOADING:

- Lectures: 3 hours/week
- Study Time: 5 hours/week
- Laboratory (5 Sessions @ 3 hours each): 1½ hour/week
- Tutorial (8-10 Sessions @ 1 hour each): 1 hours/week
- Project: 2 hours/week

Total: 12 hours/week

COURSE EVALUATION:

- Project 20%
- Power Flow Test 10%
- Mid Term 20%
- Final Exam 50%

TEXTBOOK:

- Glover, Power System Analysis and Design, ISBN:0-534-95367-0

Other related textbooks:

- J.J. Grainger and W.D. Stevenson, Power System Analysis, McGraw-Hill, 1995, Chapters 1 through 13 plus 16.
- Hadi Saadat, Power System Analysis, McGraw-Hill, 1999.

REFERENCE:

- Power Flow program manual plus other Web-based class notes and resources.

DETAILED COURSE OUTLINE

Introduction (3 hours)

- Review of power concepts
- Transformer stations
- Per Unit System

Transmission Systems (12 hours)

- Design of aerial lines and cables
- Resistance, inductance, and capacitance calculations
- Impact of ground and sky wires
- Bundling of conductors and paralleling of lines
- System equations

Power Flow and Control (6 hours)

- Network equations - assembly and reduction
- Transformers and capacitors for performance control
- Power Flow equations for system monitoring and control
- Solution algorithms - Gauss-Seidel, Newton-Raphson, Fast Decoupled
- Power flow program and model of Ontario system

Economic Operation (6 hours)

- Generation costs - fixed and variable - impact of fuel choices
- Minimizing on-line variable costs
- Inclusion of line losses and economic dispatch algorithm
- Automatic generation and system control

Fault Studies (9 hours)

- Generator characteristics and balanced faults
- Computer-based fault studies
- Symmetrical components and sequence networks
- Unbalanced short-circuit fault calculations
- Unbalanced open-circuit fault calculations
- Stability prediction and limit management
- Computer-based stability studies

(Total Course = 36 hours)

LABORATORIES:

- 1 Field Trip to McMaster Distribution Station (duration 2 to 3 hours, equivalent to a 3-hour lab), no reports are required.

Goal - observe operating practices in power engineering

- 4 Computer Simulation Sessions (3 hours each)
  - Use of PC based Power Flow Program - Introduction to Software
  - Control Transformers and MW Flows
  - Economic Dispatch
  - Test on Use of the Program

Objective - learn to operate a practical power flow program and assess its capabilities

TUTORIALS:

- 8-10 Sessions of 1 hour tutorials
  - power concepts
  - transmission
  - stations
  - economics
  - faults

Goal - self evaluation of ability to solve component modeling problems

PROJECT:

- To be discussed in the class.