SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE: Protection and Control

CODE NO. : ELR 250 **SEMESTER:** 4

PROGRAM: Electrical Engineering Technician – Power Generation

AUTHOR: R. McTaggart

DATE: 12/2006 **PREVIOUS OUTLINE DATED:** N/A

APPROVED:

_____ _____

DEAN **DATE**

TOTAL CREDITS: 4

PREREQUISITE(S): ELR 215, ELR232

HOURS/WEEK: 4

I. COURSE DESCRIPTION:

This course introduces the student to theory and devices related to protection and control of electrical power systems and equipment. Topics will include protective relaying, coordination of system protective devices, generator controls, grounding, SCADA systems, and codes and standards relating to electrical power generation.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Identify requirements for, and analyze the operation of, protective relaying systems associated with electrical generating stations.
   Potential Elements of the Performance:

   - List and describe the function of various protective relays commonly associated with generator protection
   - List and describe the function of various protective relays commonly associated with transformer protection
   - List and describe the function of various protective relays commonly associated with transmission line protection
   - Compare and contrast the operational characteristics and applications of fuses and circuit breakers
   - Describe how protective relays interface with the power system and the control system
   - Describe the construction, operation and connection of instrument transformers
   - Connect, test and analyze various instrument transformer configurations in the lab environment
   - Connect and test various protective relays in the lab environment

2. Analyze time/current characteristics of various protective devices and perform coordination studies for basic electrical power systems.
   Potential Elements of the Performance:

   - Use manufacturers' generic time current characteristic curves to develop protection schemes for specific applications
   - Develop and analyze coordination schemes for small radial electrical systems that include transformers (multiple voltage levels)
   - Identify problems associated with protection of parallel transmission lines

3. Identify and analyze components of a generating station used to control voltage, frequency, real power and reactive power.
Potential Elements of the Performance:

- List and describe various types of generator excitation systems
- Describe the components and associated functions of a turbine governor system
- List and describe indicators and controlling factors relating to the real power balance in an electrical system
- List and describe indicators and controlling factors relating to the reactive power balance in an electrical system
- Compare and contrast synchronous generator systems with induction generator systems with particular focus on wind generation
- Connect, test and analyze various generator configurations in the lab environment
- Connect and test voltage, current, frequency and power transducers

4. Identify and analyze station grounding requirements.
Potential Elements of the Performance:

- List and describe the reasons for, and requirements of, a station grounding system
- List and describe the components of a station grounding system
- Describe how to measure the impedance to ground of a grounding system
- Describe how a grounding system limits step and touch potentials within and around an electrical installation

5. Identify the components of, and requirements for, a SCADA (supervisory, control and data acquisition) system.
Potential Elements of the Performance:

- Describe the functional requirements of a typical SCADA system
- List and describe the components (block level) of a typical SCADA system
- Describe various methods a SCADA system uses to interface with field equipment

6. Identify the various codes and standards associated with generating stations.
   Potential Elements of the Performance:

   - List and describe various codes, standards and regulations associated with design and operation of generating stations
   - List and describe various codes, standards and organizations associated with electrical installations and safety

III. TOPICS:

1. Protective relaying
2. Coordination of protective devices
3. Generator control
4. Station grounding
5. SCADA systems
6. Codes and standards

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Students must provide safety glasses and basic hand tools for use in the lab (see special notes below).

V. EVALUATION PROCESS/GRADING SYSTEM:

The final grade for the course will be determined as follows:

THEORY (tests & report)	70%
LABS (see Special Note IX)	30%

See special notes below.

The following semester grades will be assigned to students in postsecondary courses:

Grade	**Definition**	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Special Needs:
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Special Needs office. Visit Room E1101 or call Extension 493 so that support services can be arranged for you.

Retention of Course Outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:
Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course Outline Amendments:
The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

Students must wear safety glasses in the lab when working on or around live circuits and equipment. Any student not doing so will be asked to leave the lab immediately. Unsafe conduct in the lab will not be tolerated.
In order to maintain a passing grade (D) the student must maintain a minimum 50% average in both the theory and lab portions of this course.
If a student misses a test or lab period he/she must have a valid reason (i.e. medical or family emergency – documentation will be required). In addition, the instructor must be notified prior to the test sitting or lab period. If this procedure is not followed the student will receive a mark of zero on the test or lab with no rewrite option.

If a student arrives late for, or is not continuously present at (scheduled breaks excepted), a scheduled lab class he/she will be considered absent for the entire class and will not be permitted to submit the associated lab report.

Students are expected to maintain an active Sault College email account. They are required to check this email account daily. The instructor may announce details of lab and test requirements and scheduling through the Sault College email system (as well as sharing other important information).

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean’s secretary. Students will be required to provide a transcript and course outline related to the course in question.

IX LAB REQUIREMENTS:

1. All lab reports are to be computer generated. Hand written reports will not be accepted.
2. All lab reports are to include a title page with the following information:

- Lab title and number
- Due date
- Date submitted
- Course number
- Names of group members
- Instructor's name

3. Lab reports are to include all procedures and observations listed in the order they were performed/taken and numbered to match the lab handout.
4. Every lab report is to conclude with a summary (whether requested in the lab document or not). The summary is to be a minimum 1 page (double spaced, Arial size 12 font, maximum 1 inch margins) in length and is to be an analysis of the results. The summary is not to be a regurgitation of the results. It is expected that students will use course notes, library resources and Internet research to assist in writing lab summaries. Labs submitted with a substandard summary will receive a grade of 0.
5. One lab report submission per group. Maximum 2 members per group.
6. Lab reports submitted with grammatical and/or spelling errors will receive a grade of 0. Word processors have spell check, it is expected students will use it.
7. Lab reports are due at the beginning of class 1 week after the scheduled period in which it was done. Late submissions will receive a grade of 0.
8. Students are not permitted to work on live equipment outside of regular class time. If a student misses all or part of a lab class he/she will not be permitted to submit the corresponding lab report.
9. Students must supply their own hand tools, protoboards, meters and safety glasses. Students will not be permitted in the lab without safety glasses and must wear the safety glasses whenever working on or around live equipment. Students must never work alone in the lab. Unsafe work habits will not be tolerated.
10. Students must sign and provide the instructor with a copy of this page before being permitted to work in the lab.

I have read and understand the above requirements:

Name (print): _____

Signature: _____

Date: _____