

I. COURSE DESCRIPTION:

Design and analysis of large and small scale electrical power systems will be studied. Topics include balanced and unbalanced faults, load flow, system stability (classical control theory utilizing Laplace Transform analysis) instrument and power transformers, protective relaying, alternative energy systems and Fourier series analysis. An integrated laboratory program supports the theory.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. Perform fault calculations for balanced and unbalanced faults in a three phase AC system.

Potential Elements of the Performance:

- Convert actual power, voltage, current and impedance values to per unit values.
- Convert per unit electrical values to actual values.
- Solve a network using per unit and/or actual values for power, voltage and current levels throughout (balanced conditions).
- Use symmetrical components to analyze unbalanced faults.

2. Analyze Basic AC Power Systems In Steady State.

Potential Elements of the Performance:

- Analyze real and reactive power flow in two and three bus systems.
- Describe real and reactive power balances and indicators for each.
- Derive and explain the static load flow equations.

3. Simplify and analyze a variety of control systems utilizing Laplace Transforms.

Potential Elements of the Performance:

- Utilize block diagrams and transfer functions to model basic control systems.
- Derive the Laplace transform of a time domain function.
- Use tables to find inverse Laplace transforms.
- Simplify block diagrams.
- Discuss criteria for system stability using Bode diagrams and s-plane analysis.

4. Assist in the design and installation of instrument and power transformers.

Potential Elements of the Performance:

- List and describe various types of large power transformers.
- List and describe various cooling methods used with large power transformers.
- List and describe name plate information provided with large power transformers.
- List and describe various protection schemes used with large power transformers.
- Describe the construction, operation and connection of instrument transformers.
- Discuss safety concerns of instrument transformers.

5. Describe the purpose and operation of various protective relays and how they interface with the power system.

Potential Elements of the Performance:

- List common electrical and mechanical faults that may occur in a power system.
- State the primary functions of protective equipment.
- Define protective relay.
- List various types of protective relays and describe their operation.
- Analyze time – current characteristic curves for various protective relays.
- Discuss the concepts of coordinated fault protection and zone coverage of power systems.
- Connect and test various protective relays.

6. Analyze the viability and application of various alternative energy systems..

Potential Elements of the Performance:

- List various types of alternative energy systems.
- Describe where and how commercially available alternative energy systems are currently being utilized.
- Describe alternative energy systems proposed for future use (i.e. in prototype stage).

7. Analyze periodic, non-sinusoidal waveforms.

Potential Elements of the Performance:

- Define harmonics and describe their affect on electrical power systems.
- Use Fourier series analysis to determine the harmonic content of various periodic, non-sinusoidal waveforms.

III. TOPICS:

1. Fault Analysis
2. Steady State Analysis of Power Systems
3. Control Systems
4. Instrument and Power Transformers
5. Protective Relays
6. Alternative Energy Systems
7. Fourier Series Analysis

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Notes supplied by instructor.

Safety Glasses, Class 00, 500 volt, Insulating Rubber Gloves with Leather protector gloves, multimeter, hand tools.

V. EVALUATION PROCESS/GRADING SYSTEM:

Theory Tests *	60%
Laboratory Work *	25%
Research Report*	10%
Presentation of Research Report*	5%
Total	100%

- Refer to **SPECIAL NOTES** and **LAB REQUIREMENTS**.

The following semester grades will be assigned to students:

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

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.

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.

Prior Learning Assessment:

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question. Please refer to the Student Academic Calendar of Events for the deadline date by which application must be made for advance standing.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.

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

Disability Services:

If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Disability Services office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

Communication:

The College considers **WebCT/LMS** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the **Learning Management System** communication tool.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Code of Conduct*. A professor/instructor may assign a sanction as defined below, or make recommendations to the Academic Chair for disposition of the matter. The professor/instructor may (i) issue a verbal reprimand, (ii) make an assignment of a lower grade with explanation, (iii) require additional academic assignments and issue a lower grade upon completion to the maximum grade “C”, (iv) make an automatic assignment of a failing grade, (v) recommend to the Chair dismissal from the course with the assignment of a failing grade. 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.

Student Portal:

The Sault College portal allows you to view all your student information in one place. **mysaultcollege** gives you personalized access to online resources seven days a week from your home or school computer. Single log-in access allows you to see your personal and financial information, timetable, grades, records of achievement, unofficial transcript, and outstanding obligations, in addition to announcements, news, academic calendar of events, class cancellations, your learning management system (LMS), and much more. Go to <https://my.saultcollege.ca>.

Electronic Devices in the Classroom:

Students who wish to use electronic devices in the classroom will seek permission of the faculty member before proceeding to record instruction. With the exception of issues related to accommodations of disability, the decision to approve or refuse the request is the responsibility of the faculty member. Recorded classroom instruction will be used only for personal use and will not be used for any other purpose. Recorded classroom instruction will be destroyed at the end of the course. To ensure this, the student is required to return all copies of recorded material to the faculty member by the last day of class in the semester. Where the use of an electronic device has been approved, the student agrees that materials recorded are for his/her use only, are not for distribution, and are the sole property of the College.

Attendance:

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

Other:

Attendance to scheduled lab activities is compulsory, unless permission has been granted by the instructor. Lab attendance and final grade are directly related. If a student arrives late for, or is not continuously present and actively participating 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 must continuously wear all Sault College required personal protective equipment (PPE) during lab activities. Failure to do this will result in expulsion from the lab activity and a grade of zero being assigned. Students are expected to be wearing their required PPE prior to entering the lab. The instructor will advise what specific PPE is required. If a student repeatedly neglects to wear PPE as required he/she will be considered to be in violation of the Sault College Academic Code of Conduct and may be sanctioned accordingly (see Student Code of Conduct & Appeal Guidelines). For instance, first violation – verbal warning, second violation written warning, third violation suspension from lab activities. Students must complete a lab safety orientation prior to participating in lab activities. Successful completion of this orientation will be demonstrated by the student completing a quiz with a minimum grade of 100%.

If a student misses a test/lab he/she must have a valid reason (i.e. medical or family emergency – documentation may be required). In addition, the instructor **must** be notified **prior** to the test or lab sitting. If this procedure is not followed the student will receive a mark of zero on the test/lab with no make-up option. Students may not submit lab reports for labs in which they were not in continuous attendance. Lab reports not submitted by the assigned deadline will receive a grade of 0.

Use of cell phones/PDAs for any form of communication (voice, text...) during class or lab time is strictly prohibited. Cell phones/PDAs must be silenced during regular class and lab times and must be turned off and kept out of sight during test sittings. Failure to follow the latter requirement during a test sitting will result in a grade of 0 being assigned.

Students may not wear earphones of any kind (i.e. for play back of recorded music/voice) during lab activities or test sittings. This does not include hearing aids required for hearing impaired.

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).

Any request to deviate from the aforementioned course outline requirements must be made to the instructor in writing or via Sault College email. If permission is granted it must also be granted in writing or via Sault College email. Verbal requests/permissions are not acceptable. It is the student's responsibility to maintain a copy of all such requests and associated permissions.

VII. LAB REQUIREMENTS:

1. All lab reports are to be computer generated. Hand written reports will not be accepted. Circuit diagrams are to be generated using AutoCad.
2. All lab reports are to include a title page with the following information in the following sequence:
 - 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, observations and questions listed in the order they appear in the lab handout and numbered to match the lab handout. Students will typically be provided with the Word file for the lab handout. They are expected to generate their lab submission from this file so all submissions follow one format and include all original documentation. Failure to follow this format will result in a grade of 0 being assigned.
4. One lab report submission per group. Maximum 2 members per group unless approved by the instructor.
5. 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.
6. 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. It is recommended students submit lab reports prior to the deadline to avoid late submissions due to unforeseen circumstances (i.e. bad weather, transportation problems...).
7. Students are not permitted to work on live equipment outside of regular class time and may not work in the lab without faculty permission. This permission will not be considered outside of the regular 8:30am to 4:30pm, Monday – Friday time period. If a student misses all or part of a lab class he/she will not be permitted to submit the corresponding lab report.
8. Students must supply their own personal protective equipment (PPE). Students will not be permitted in the lab if not wearing required PPE. Students must never work alone in the lab. Unsafe work habits will not be tolerated.
9. Students are expected to maintain a clean and organized work area. Failure to put away equipment (in assigned location) and to clean up after a lab activity will result in a grade of 0 being assigned for that activity.

VIII. Research Report Requirements:

1. This will be a formal report and presentation to the class.
2. Students will work in pairs.
3. Three copies of the report are to be prepared. One to be submitted and one for each member of the group. Each report to consist of:
 - a. Title page including name of report, course ID, authors, instructor's name.
 - b. Table of Contents.
 - c. Summary - brief summary of report contents/conclusions.
 - d. Main body of report. Minimum 6 pages, Ariel 12 point font, $\frac{3}{4}$ " margins, 1" header and 1" footer, double spaced (using the same spacing between lines as in this sentence), maximum one extra line between paragraphs.
Bibliography. All information must be sourced. Any direct quotations must be shown as such and sourced.
 - e. Use of pictures, drawings and diagrams will increase the length of the main body accordingly.
4. Presentation to be PowerPoint and minimum length 30 minutes (20 minute presentation 10 minutes question and answer allowance). A copy of the PowerPoint file is to be submitted to the instructor prior to the presentation to the class.
5. Topics must be approved by the instructor and will be based on Alternative Energy Systems and Learning Outcome 6.
6. Report to be submitted no later than 9:00 AM March 31, 2010. Late reports will receive a grade of 0. It is recommended a rough draft is submitted two weeks prior to this date for preliminary feedback.