



**I. COURSE DESCRIPTION:**

This course is a study of the production, delivery and utilization of electrical power. Transmission and distribution equipment, system configurations, protection and control, electrical load fundamentals and the Canadian Electrical Safety Code will be discussed and analyzed.

**II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:**

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

**1. Perform basic per unit calculations for three phase alternating current systems.**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.
- Reduce series/parallel networks to a single source/single impedance network.
- Solve a network using per unit and/or actual values for power, voltage and current levels throughout (balanced conditions).
- State the advantages and disadvantages of using the per unit method for calculating electrical parameters of power systems.
- Describe how real power flow is controlled in a power system and state the corresponding system indicators.
- Describe how reactive power flow is controlled in a power system and state the corresponding system indicators.

**2. Describe various options presently available for bulk generation of electrical power as well as those under consideration for future use.**Potential Elements of the Performance:

- Describe the history of bulk electrical power generation in North America.
- State the three major categories of bulk electrical power generating stations in use today.
- State and briefly describe alternative sources of power generation that are presently being utilized.
- State and briefly describe potential future sources of electrical energy that are presently in the design or test stage.
- Identify all major mechanical and electrical components of a typical hydro generating station.
- Identify all major mechanical and electrical components of a typical thermal generating station.
- State the common types of nuclear generating stations.

- Identify all major mechanical and electrical components of common nuclear generating stations..
- Discuss components common to thermal and nuclear generating stations
- Identify all major mechanical and electrical components of common wind power generating stations.

**3. Describe alternating current (ac) and direct current (dc) transmission systems and their components.**

Potential Elements of the Performance:

- Identify, state the purpose of, and describe each major component of an overhead transmission line.
- Describe corona and associated problems.
- Describe how lightning is created and its potential effects on a transmission line.
- Describe and draw equivalent circuits for short, medium length and long ac transmission lines.
- State how line impedance affects maximum power transfer of an ac transmission line.
- List and comment on the advantages and disadvantages of dc power transmission.
- Describe the various types of high voltage dc converter stations.

**4. Describe transmission and distribution substations and their functions.**

Potential Elements of the Performance:

- State the difference between transmission and distribution and describe how their definitions may vary to match given situations.
- List and describe the major components of a substation.
- List and describe the major categories of circuit breakers.
- Describe the operation and applications of various types of circuit breakers.
- Describe various 'name plate' parameters used to identify ratings and capacities of substation equipment.
- Describe the purpose of system grounding.
- Describe basic substation grounding design.

**5. Describe the purpose of 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 common 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.
- Define symmetrical components using the alpha operator.

**6. *Describe the effects of harmonics on electrical power systems.***

Potential Elements of the Performance:

- Define harmonics.
- List and describe terms used to quantify the effects of harmonics.
- List components of a power system susceptible to damage from harmonics and describe what damage may occur and how to prevent or minimize it.

**7. *Interpret and apply the Canadian Electrical Code (CSA C22.1).***

Potential Elements of the Performance:

- Describe the purpose and layout of the Canadian Electrical Code.
- Identify and apply appropriate Sections, Rules and Tables relating to electrical cabling and conductor ampacities.
- Identify and apply appropriate Sections, Rules and Tables relating to grounding and bonding.
- Identify and apply appropriate Sections, Rules and Tables relating to the installation of electrical equipment.

**III. TOPICS:**

1. Power System Analysis
2. Power Generation
3. Power Transmission
4. Substations
5. Protective Relays
6. Harmonics
7. Canadian Electrical Code

**IV. REQUIRED RESOURCES/TEXTS/MATERIALS:**

Resource materials are available in the Sault College Library, from the instructor and on the Internet. No text purchase is required.

**V. EVALUATION PROCESS/GRADING SYSTEM:**

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

**3 or 4 equally weighted tests: 100%**

See "Special Notes" below.

The following semester grades will be assigned to students:

<b>Grade</b>	<b><u>Definition</u></b>	<i>Grade Point Equivalent</i>
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.	

If a faculty member determines that a student is at risk of not being successful in their academic pursuits and has exhausted all strategies available to faculty, student contact information may be confidentially provided to Student Services in an effort to offer even more assistance with options for success. Any student wishing to restrict the sharing of such information should make their wishes known to the coordinator or faculty member.

## VI. SPECIAL NOTES:

### 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 course specific):

If a student misses a test 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 sitting. If this procedure is not followed the student will receive a mark of zero on the test with no make-up option. Make-ups for missed tests (only with valid reason and documentation) will be written the week following the end of the semester. If this is not practical for the instructor an X grade may be issued.

If a student misses class time due to sickness, family emergency or other reason beyond his/her control the student must at his/her first opportunity meet with the course faculty to discuss if the missed time has placed the student at an increased risk of failing. The student must follow up the meeting by emailing the faculty with a summary of the meeting's discussions. Documentation validating the missed time may be required.

**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).

## VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.