## SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

## SAULT STE. MARIE, ONTARIO


# COURSE OUTLINE

**COURSE TITLE:** ELECTRICAL MACHINES

**CODE NO. :** ELR 232 **SEMESTER:** THREE

**PROGRAM:** ELECTRICAL ENGINEERING TECHNICIAN/TECHNOLOGY

**AUTHOR:** R. McTaggart

**DATE:** 05/2004 **PREVIOUS OUTLINE DATED:** 05/2003

**APPROVED:**

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**DEAN** **DATE**

**TOTAL CREDITS:** 7

**PREREQUISITE(S):** ELR 109

**HOURS/WEEK:** 5

## I. COURSE DESCRIPTION:

This course is an analytical study of characteristics, performance and control of rotating electrical machinery, transformers and associated equipment. 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. Analyze and test direct current (dc) motors and generators.

   Potential Elements of the Performance:
   - Describe the construction of dc machines.
   - Describe how a dc generator generates voltage.
   - Describe how a dc motor develops torque.
   - Perform calculations to determine electrical, mechanical and magnetic operating parameters of dc machines.
   - Connect and test various configurations of dc machines.

2. Analyze and test single and polyphase transformers.

   Potential Elements of the Performance:
   - Describe the construction of various power, control and instrument transformers.
   - Describe the principles of operation of ideal and real transformers.
   - Utilize phasor diagrams to explain the characteristics of transformers operating at various power factors.
   - Perform calculations involving power, voltage, current and flux.
   - Connect and test various configurations of single and polyphase transformers.
   - Describe safety issues regarding transformers.

3. Analyze and test three phase alternating current (ac) generators.

   Potential Elements of the Performance:
   - Describe the construction of ac synchronous generators.
   - Perform calculations to determine electrical, mechanical and magnetic operating parameters of ac synchronous generators.
   - Utilize phasor diagrams to explain the characteristics of ac synchronous generators operating at various power factors and under various load conditions.
   - Connect and test ac synchronous generators.

4. Analyze and test single and polyphase ac induction motors.

   Potential Elements of the Performance:
   - Describe the construction of three phase ac induction motors.
   - Describe how a rotating magnetic field is set up in a three phase ac motor.
   - Describe how torque is developed by a three phase induction motor.
   - Describe the construction of various types of single phase induction motors.
   - Describe how torque is developed by single phase induction motors.
   - Perform calculations to determine electrical and mechanical operating parameters of ac induction motors.
   - Connect and test various types of ac induction motors.

5. Analyze and test single and polyphase ac synchronous motors.

   Potential Elements of the Performance:
   - Describe the construction of a three phase synchronous motor.
   - Describe how a synchronous motor develops torque.
   - Describe methods of starting synchronous motors.
   - Perform calculations to determine electrical, mechanical and magnetic operating parameters of ac synchronous motors.
   - Utilize phasor diagrams to explain the characteristics of ac synchronous motors operating at various power factors and under various load conditions.
   - Describe how synchronous motors are used for power factor correction and perform related calculations.
   - Describe the construction and operation of common fractional horsepower single phase synchronous motors.

6. Construct and test various motor control circuits.

   Potential Elements of the Performance:
   - Describe power and control components of typical ac and dc motor control schemes.
   - Define wiring diagram, schematic diagram, ladder logic, relay logic.
   - Draw and interpret wiring, schematic, ladder logic and relay logic diagrams.
   - Connect and test various motor control circuits.

## III. TOPICS:

1. Direct Current Machines
2. Transformers
3. Synchronous Generators
4. Induction Motors
5. Synchronous Motors
6. Motor Control

## IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Electric Machinery 2nd Edition by Peter F. Ryff
ISBN 0-13-475625-8

## V. EVALUATION PROCESS/GRADING SYSTEM:

| | |
|---|---|
| Theory Tests* | 70% |
| Laboratory Work* | 30% |
| Total | 100% |

*Refer to SPECIAL NOTES items 4 and 6.
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. |

**VI.** SPECIAL NOTES:

1. 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 instructor and/or the Special Needs office. Visit Room E1204 or call Extension 493 so that support services can be arranged for you.

2. 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.

3. 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.

4. 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.

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

6. Attendance to scheduled lab activities is compulsory, unless permission has been granted by the instructor (see note #7). Lab attendance and final grade are directly related.

7. The student must maintain a minimum 50% average in **both** the **theory** portion **and lab** portion of the class in order to receive a passing grade. 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 attendance.

## VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the instructor. Credit for prior learning will be given upon successful completion of the following:

## 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.