SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE MARIE, ON

COURSE OUTLINE

Course Title: ELECTRICAL MACHINES

Code No.: ELR 232-6 **Semester:** THREE

Program: ELECTRICAL TECHNICIAN/TECHNOLOGY

Author: R. McTAGGART

Date: 06/1998 **Previous Outline Date:** 05/1991

Approved: K. DeRosario — Dean; June 18/98 — Date

Total Credits:
Length of Course:
Prerequisite(s): ELR 109
Total Credit Hours: 96

Copyright © 1997 The Sault College of Applied Arts & Technology
Reproduction of this document by any means, in whole or in part, without the prior written permission of The Sault College of Applied Arts & Technology is prohibited. For additional information, please contact Kitty DeRosario, Dean, School of Trades & Technology Studies, (705) 759-2554, Ext. 642.

RECEIVED
JUN 19 1998
SAULT COLLEGE LIBRARY
SAULT STE. MARIE

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

I. COURSE DESCRIPTION:

This course is an analytical study of characteristics, performance and control of direct current generators and motors, single and polyphase induction motors, polyphase synchronous machines and transformers. Theory is supported by an integrated laboratory program.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

(Generic Skills Learning Outcomes placement on the course outline will be determined and communicated at a later date.)

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

1) Analyze the operation of various types of direct current (dc) generators.

Potential Elements of the Performance:

- state the types, configurations and characteristics of commonly used dc generators
- state how dc generators are constructed
- draw connection diagrams for the various configurations of dc generators
- use electrical circuit theory to analyze and predict the operation of dc generators
- connect, test and control dc generators in the lab environment

2) Analyze the operation of various types of direct current (dc) motors.

Potential Elements of the Performance:

- state the types, configurations and characteristics of commonly used dc motors
- state how dc motors are constructed, how they develop torque and discuss their torque speed characteristics
- draw connection diagrams for the various configurations of dc motors
- use electrical circuit theory to analyze and predict the operation of dc motors
- connect, test and control dc motors in the lab environment

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE (Continued)

3) Analyze the operation of various types of single and polyphase transformers.

Potential Elements of the Performance:

- state the principle of operation of a simple two winding transformer
- draw and explain the complete equivalent circuit of a simple two winding transformer
- use electrical circuit theory and phasor diagrams to analyze and predict the operation of a simple two winding transformer for resistive, capacitive, inductive and combination loads
- analyze the operation of an autotransformer
- state and draw the various types of three phase transformer configurations
- use phasor diagrams to show the phase relationships between primary, secondary and tertiary voltages and currents in three phase transformers
- state the purpose and meaning of each element of transformer nameplate data
- perform calculations related to polyphase transformer applications
- explain how to use a transformer to produce six phase power from three phase
- apply transformer theory to analyze instrument transformer applications
- state safety problems associated with instrument transformers
- connect and test various transformer configurations in the lab environment

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

4) Analyze the operation of various types of alternating current (ac) synchronous generators

Potential Elements of the Performance:

- state the types, configurations and characteristics of commonly used synchronous generators
- state how a synchronous generator is constructed
- draw connection diagrams for the various configurations of synchronous generators
- state how to synchronize an ac generator to a live bus
- use electrical circuit theory and phasor diagrams to analyze and predict the operation of ac generators
- connect, test and control ac generators in the lab environment

5) Analyze the operation of various types of alternating current (ac) motors.

Potential Elements of the Performance:

- state the types, configurations and characteristics of commonly used polyphase induction motors
- state how a rotating magnetic field is created by the stator of a three phase induction motor
- state how polyphase induction motors are constructed and how torque is developed
- discuss how rotor construction is used to produce specific torque - speed characteristics
- draw and explain the electrical equivalent circuit for a squirrel cage induction motor
- state the types, configurations and characteristics of commonly used single phase ac motors
- state how single phase motors are started and how operating torque is developed
- connect, test and control ac motors in the lab environment

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

6) Analyze the operation of various types of alternating current (ac) synchronous motors

Potential Elements of the Performance:

- state the types, configurations and characteristics of commonly used synchronous motors
- state how synchronous motors are constructed and how they develop torque
- draw connection diagrams for the various configurations of synchronous motors
- state how to start an ac synchronous motor
- use electrical circuit theory and phasor diagrams to analyze and predict the operation of ac synchronous motors
- state how ac synchronous motors are used for power factor correction
- perform calculations dealing with power factor correction and power/torque development
- connect, test and control ac synchronous motors in the lab environment

7) Analyze and develop relay logic control circuits for ac and dc rotating machines

Potential Elements of the Performance:

- state the common components of a relay logic circuit and identify their corresponding symbols
- prepare and analyze schematic diagrams, wiring diagrams and relay ladder logic diagrams
- develop, connect and test various motor control circuits in the lab environment

8) Identify various types of special purpose motors

Potential Elements of the Performance:

- briefly outline the construction and operating principles of permanent-magnet dc motors, servomotors, brushless dc motors, tachometers, stepper motors, linear induction motors and eddy current clutches

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

III. TOPICS:

1) Direct current generators

2) Direct current motors

3) Transformers

4) Alternating current generators

5) Alternating current motors

6) Synchronous motors

7) Motor control

8) Special purpose motors

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Electrical Machinery, 2nd Edition by Peter F. Ryff

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

V. EVALUATION PROCESS/GRADING SYSTEM

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

THEORY	70%
LABS	30%

The grading system used will be as follows:

A+	90 to 100%
A	80 to 89%
B	70 to 79%
C	55 to 69%
R	< 55% in theory and/or project component (repeat course)

VI. SPECIAL NOTES:

- In order to maintain a passing grade the student must obtain a minimum 55% average in both the theory and lab portions of the course
- If a student misses a test he/she must have a valid reason (ie. medical or family emergency). In addition, the school must be notified before the scheduled test sitting. The student should contact the instructor involved. If the instructor cannot be reached leave a message with the Dean's office or the College switchboard. If this procedure is not followed the student will receive a mark of zero on the test with no rewrite option.

- Special Needs
  If you are a student with special needs (eg. physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717, 491 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 post-secondary institutions.

- Disclaimer for Meeting the Needs of the Learners

- Substitute Course Information is available at the Registrar's Office.

ELECTRICAL MACHINES
COURSE NAME

ELR 232
COURSE NUMBER

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: