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

COURSE OUTLINE

Course Title: POWER ELECTRONICS

Code No.: ELR 236-6 Semester: FOUR

Program: ELECTRICAL TECHNICIAN/TECHNOLOGY

Author: R. McTAGGART

Date: Jan. 2002 Previous Outline Date: Jan.2000

Approved: _____ _____
Dean Date

Total Credits: 6 Prerequisite(s): ELR109, ELN213
Length of Course: 16 weeks Total Credit Hours: 96

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I. COURSE DESCRIPTION:

This course furthers the students' knowledge of power electronic devices and applications.

Solid state drive packages and associated power and control circuitry are introduced. Lab exercises will provide the students with hands-on experience with typical commercial AC and DC motor drives.

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 diode and rectifier circuits.

Potential Elements of the Performance:

- describe energy transfer between inductors and capacitors in diode/RLC circuits

- state the various types of diode rectifier circuits and draw the associated circuit diagrams

- choose the correct type and rating of rectifier diode for a given application

- draw associated voltage waveforms for single phase, three phase and six phase diode rectifiers

- connect, test and troubleshoot diode rectifier circuits

2) Understand the operating characteristics of Thyristors and Power Transistors.

Potential Elements of Performance:

- state the five major categories of power electronic switching devices

- describe the operating characteristics of power SCRs, BJTs, MOSFETs and IGBTs

- connect and test simple power electronic switching circuits in the lab environment

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

3) Analyze various types of SCR commutation circuits.

Potential Elements of the Performance:

- define natural and forced commutation

- draw and describe the operation of various forced commutation circuits

4) Analyze the operation of various types of single and polyphase controlled rectifier circuits

Potential Elements of the Performance:

- describe the principle of phase controlled converter operation

- draw circuit diagrams for, and describe the operation of, single and three-phase semi-converters, full-converters and dual converters

- describe the effects of an inductive load on a various controlled rectifiers

- describe the effects of controlled rectifiers on system power factor and harmonic content

- draw voltage and current waveforms associated with the various converter circuits

- build and test a three phase controlled rectifier

5) Analyze the operation of various types of static switches.

Potential Elements of the Performance:

- draw circuit diagrams for, and describe the operation of, various AC and DC static switches

- describe common applications of static switches

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

6) Analyze the operation of various types of AC voltage controllers.

Potential Elements of the Performance:

- draw circuit diagrams for, and describe the operation of, various AC voltage controllers

- draw voltage waveforms associated with various AC voltage controllers

- describe common applications of AC voltage controllers

7) Analyze the operation of various types of DC chopper circuits.

Potential Elements of the Performance:

- describe the principle of operation of a step down (buck) chopper

- describe the principle of operation of a step up (boost) chopper

- describe the operation of specific buck, boost and buck/boost chopper circuits

- build a chopper circuit using a power transistor to control the armature voltage of a DC motor

8) Analyze the operation of various types of inverter circuits.

Potential Elements of the Performance:

- draw circuit diagrams for, and describe the operation of, common single and three phase inverters

- draw voltage waveforms associated with common inverters

- describe how pulse width modulation is used for wave shaping

- draw circuit diagrams for, and describe the operation of, various resonant pulse inverters

- draw voltage waveforms associated with various resonant pulse inverters

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

9) Analyze the operation of various types of DC motor drives.

Potential elements of performance:

- state the three general classifications of DC motor drives
- describe the basic electrical and mechanical characteristics of DC motors
- describe how DC drives are used to control the operation of DC motors
- identify power and control sections of DC drive circuitry and produce simplified block diagrams of specific DC motor drives in the lab
- connect and test DC drives in the lab

10) Analyze the operation of various types of AC motor drives.

Potential elements of performance:

- state the two general classifications of AC motor drives
- describe the basic electrical and mechanical characteristics of AC motors
- describe how AC drives are used to control the operation of AC motors
- identify power and control sections of AC drive circuitry and produce simplified block diagrams of specific AC motor drives in the lab
- connect and test AC drives in the lab

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

11) Analyze the operation of various types of industrial power supplies.

Potential elements of performance:

- state the general requirements for industrial power supplies
- describe the operation of switched-mode, resonant and bidirectional DC power supplies
- describe the components of a basic UPS system
- state the purpose of multistage AC power supplies
- describe the operation of various multistage AC power supplies

III. TOPICS:

1) Diodes and diode rectifiers
2) Thyristors and power transistors
3) SCR commutation circuits
4) Controlled rectifiers
5) Static switches
6) AC voltage controllers
7) DC choppers
8) Inverters
9) DC motor drives
10) AC motor drives
11) Power Supplies

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IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Power Electronics: Circuits, Devices, and Applications Second Edition
By: M. H. Rashid

V. EVALUATION PROCESS/GRADING SYSTEM

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

THEORY	70%
LABS	30%

Theory and Lab classes must be independently passed.

The grading system used will be as follows:

A+	90 to 100%
A	80 to 89%
B	70 to 79%
C	60 to 69%
R	59% or below (repeat course)

VI. SPECIAL NOTES:

- In order to maintain a passing grade the student must obtain an overall average of at least 60% and a minimum of 60% in both the theory and lab portions (ie. a 100% lab mark and a 56% theory mark would result in an R grade).
- If a student misses a test or a lab he/she must have a valid reason (ie. medical or family emergency). In addition, the school must be notified before the scheduled class. 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 or lab with no rewrite option.

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VI. SPECIAL NOTES: (Continued)

- 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.

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: