SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE: AUTOMATIC ELECTRICAL SYSTEMS

CODE NO. : ELR 320-7   **SEMESTER:** FIVE

PROGRAM: ELECTRICAL TECHNOLOGY

AUTHOR: R. CHARTRAND

DATE: 08/2000   **PREVIOUS OUTLINE DATED:**   09/1999

APPROVED:

_____   _____
                                    DEAN   DATE

TOTAL CREDITS: 7

PREREQUISITE(S): ELR223

HOURS/WEEK: 5

I. COURSE DESCRIPTION:

The student will develop an understanding of control system integration equipment such as different PLCs, MMIs, AC & DC drives, instrumentation and Industrial Network Basics. Advanced PLC techniques using Allen Bradley PLC5 family and the Slick 500 family PLCs will be used to Connect, commission and document individual sections and components of an automated control systems and a basic Industrial Network again using Allen Bradley equipment. The student will interface PLC control with selected equipment to form the bases to control industrial drives and process control loops.

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.)

Potential Elements of the Performance:

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

a) Identify and list the equipment and components that make up a basic Automated Industrial Control System Network Identify and state the function of components of the Basic Industrial Network
Identify and state the function of the three levels of a Basic Industrial Network
State the function, and characteristics of the Information Level, Control Level and The device Levels of a Basic Industrial Control Network using the Allen Bradley Model
Discuss the Basic function, advantages, and limitations of Allen Bradley's Industrial Network designs.
The device Levels of a Basic Industrial Control Network using the models similar to the Allen Bradley Model
Discuss the Basic function, advantages, and limitations of other Industrial Network designs.
State different network terms and describe there use and meaning as applied to Industrial Networks, terms such as Industrial Ethernet, Producer/consumer, gateways, bridges, cat-5 cabling etc.
Identify and list the equipment and components that make up a basic automated control system
Identify and state the function of components of the SLC 500 Family PLCs
State the function, operation and set-up of analog cards used on PLC 5 and SLC 500 series PLC

Discuss the function, advantages, and limitations of PLCs in Industrial Process Control Loops.

Discuss the basic functions of Motor Drive as they relate to PLC control and interface

Discuss the function of PID PLC software control blocks for the PLC 5 and SLC 500 series PLCs.

State the difference between Remote I/O, Adaptor Mode, and Scanner Model operation of PLCs and their interfaced components

Discuss the function of Message block commands used in Peer to Peer Communications for PLC 5 and Slick 500 series PLCs.

b) Upon successful completion of the lab portion of the course the student will demonstrate the ability to:

Develop advance PLC 5 programs to control various electrical equipment

Develop advance PLC Slick 500 programs to control various electrical equipment

Program PLC 5 processors using RSlogic programming software

Program PLC Slick-500 processors using RSlogic-500 programming software

Configure PLC Analog input and output interfacing modules

Configure PLC, PID software advance instructions

Program a PLC to control a single loop process

Configure and program PLC for both scanner and adaptor mode operations

Configure and program PLC peer to peer communications for data exchange

III.   TOPICS:

1)   Overview of control terminology and principles.

2)   Overview of industrial controls and automation hardware/software.

3)   Overview of AB PLC 5 and Slick 500 software.

4)   Overview of PLC/PC networking.

5)   Advanced PLC programming.

6)   Overview of Motor drive control with PLCs.

7)   Introduction to process control.

8)   Introduction to Industrial Networks and associated equipment and terminology

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Required resources will be supplied by the instructor when available therefore the student may be required to purchase material such material if the instructor can not supply it. The student will be informed of the material required to purchase along with the cost and availability at the beginning of the course or with a minimum of 4 weeks notice prior to requiring it for course study.

V. EVALUATION PROCESS/GRADING SYSTEM:

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

Tests	100 marks	33% overall
Lab Practical / written Test	75 marks	25% overall
Lab Write-ups	75 marks	25% overall
Lab Demonstration	50 marks	17% overall
Total	300 marks	100%

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%	3.75
B	70 - 79%	3.00
C	60 - 69%	2.00
R (Repeat)	59% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field placement or non-graded subject areas.	
U	Unsatisfactory achievement in field placement or non-graded subject areas.	
X	A temporary grade. This is used in limited situations with extenuating circumstances giving a student additional time to complete the requirements for a course (see *Policies & Procedures Manual – Deferred Grades and Make-up*).	
NR	Grade not reported to Registrar's office. This is used to facilitate transcript preparation when, for extenuating circumstances, it has not been possible for the faculty member to report grades.	

VI.   SPECIAL NOTES:

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, 717, or 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 postsecondary institutions.

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.

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.

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

SPECIAL NOTES Continued….

- In order to maintain a passing grade the student must obtain a minimum 60% average in both the theory Tests, Lab Practical/Written Tests, Lab Write-ups and Demonstrations of Labs to Instructor of the course.
- If a student misses a test he/she must have a valid reason (eg. Medical or family emergency). A Doctors Slip may be requested by the instructor if a test or deadline is missed due to a medical 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.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

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.

Requirements for Lab Write-ups

Labs 1A and 1B require no write-ups

Lab #2 through and including Lab #13 all require write-ups and demonstration as outlined below.

3) Labs shall have a ladder logic diagram print out including documentation for both the Emulation portion and the actual PLC running portion of the Lab
4) Labs shall have a Hardwire Schematic Diagram completed in AutoCAD or an acceptable alternate software drawing program
5) Labs shall have an AutoCAD or other acceptable software drawing program of a complete lab wiring diagram which will include all lab associated equipment, PLC processors, cards, racks along with lights, switches and wires where applicable.
6) Labs shall have an I/O listing
7) Labs shall have a brief description of operation and function described in the students own words and it shall be typed using a word processor program such as WordPerfect, etc.
8) All lab assignments must be turned in on hard copy and on computer disk(s) before or no later than the last lab class of the semester. The disk(s) will contain all program drawings, wordprocessor write-ups and PLC programs.
9) Labs that require tables shall be done in a spread sheet or a word processor that can produce a table
10) Each lab may have specific requirements which the instructor will inform the students during the lab period. These requirements may include changes to the equipment, procedure, write-ups, demonstrations or any other requirement that the instructor deem as necessary. So all students must attend the labs to obtain any of the specific requirement. These will only be given out on the day that the particular lab is scheduled.
11) If the student is not clear on any of the lab requirements, it is his/her responsibility to ask the instructor for clarification.
Notes:
Each student must demonstrate the lab to the instructor and turn in a write-up as outlined. The student must obtain a passing mark (grade) in each area of the course as described below:
♦ Tests, including practical test, student must obtain a minimum of 60%
♦ Write-up, student must obtain a minimum of 60% and hand in write-ups for all 12 labs (2 to 13) to obtain a grade in this portion of the course
♦ Demonstration, student must obtain a minimum of 60% and the student must have demonstrated all 12 labs (2 to 13) to obtain a grade in this portion of the course

ELR320 GRADING AND MARKS

		Approx.
Theory Test #1	20 Marks	5% overall
Theory Test #2	30 Marks	11% overall
Theory Test #3	50 Marks	17% overall
Practical Test #1	50 Marks	17% overall
Practical Written Test #1	25 Marks	8% overall

Write-ups	Demonstration	
0 marks	0 marks	0% overall
5 marks	5 marks	3.4% overall
5 marks	5 marks	3.4% overall
0 marks	0 marks	0% overall
0 marks	0 marks	0% overall
5 marks	5 marks	3.4% overall
5 marks	5 marks	3.4% overall
5 marks	5 marks	3.4% overall
10 marks	5 marks	5% overall
10 marks	5 marks	5% overall
10 marks	5 marks	5% overall
10 marks	5 marks	5% overall
Total 75 marks	50 marks	42% overall

Theory Tests	100 marks	33% overall
Practical Lab Tests	75 marks	25% overall
Write-ups	75 marks	25% overall
Demonstrations	50 marks	17% overall
Total	300 marks	100%

Grades:

A+	90 - 100%
A	80 - 89%
B	70 - 79%
C	60 - 69%
R (Repeat)	59% or below

ELR 320-7 Fifth **Semester**

6	SLC 500 ,, 2в504,, 3-503,, 1в502
4	analog in and out
3	panel mates
5	input and output sets
1	scanner card
1	DMC card
6	Link couplers RS 485

3	1336
2	1336 plus
2	1305

3	smc with 2 interfaces discrete
1	smc remote I/O
1	SMC with built in discrete interface

10	AB 5 Family Processors and Rack with 24 VDC Discrete I/O
4	Analog In and also Out Cards for the AB 5 Processors

Review HMI software

	Fall **99**	ELR 320 -7 Automated Systems Lab Theory And Labs For 16 Weeks
WKs		

1	**TH**	AB-5 HARDWARE AND SOFTWARE SET UP OF ANALOG IN / OUT CARDS
1	**LAB TH**	AB-5 HARDWARE AND SOFTWARE SET UP OF ANALOG IN / OUT CARDS
2	**TH**	BASIC SLC 500 HARDWARE , OPERATIONAL THEORY , ADDRESSING AND INTRODUCTION TO RS LOGIC 500
2	**LAB TH**	BASIC SLC 500 HARDWARE , OPERATIONAL THEORY , ADDRESSING AND INTRODUCTION TO RS LOGIC 500
3	**TH**	AB-5 SOFTWARE SET UP OF ANALOG IN / OUT CARDS WITH PID AND MATH FUNCTION IN LADDER LOGIC PROGRAMMING
3	**LAB # 1**	LAB SET-UP AND MOUNT HARDWARE BOTH AB-5 LAB #1A AND SLC 500 SERIES LAB # 1B
4	**TH**	SLC 500 ANALOG IN / OUT
4	**LAB # 2**	SET-UP AB-5 ANALOG IN AND OUT CARDS
		NOTE READ SECOND YEAR NOTES ON AC & DC DRIVES
5	**TH**	SLC 500 ANALOG IN / OUT AND PID AND OTHER MATH FUNCTIONS
5	**LAB # 3**	SET-UP ANALOG IN AND OUT CARDS ALONG WITH THE PID BLOCK AND PERFORM AN OPEN LAB ASSIGNMENT
6	**TH**	REVIEW FOR TEST ON ALL MATERIAL INCLUDING LABS
6	**LAB # 4**	SMC / 1305 / 1336
7	**TH**	TEST ON ALL MATERIAL INCLUDING LABS
7	**LAB # 5**	SMC / 1305 / 1336

8	TH	AB-5 REMOTE I/O AND ADAPTOR MODE
8	LAB # 6	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONTROL 3 MOTORS
9	TH	AB-5 REMOTE I/O SLC 500
9	LAB # 7	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONTROL TRAFFIC LIGHT USING TIMERS LIMIT TEST AND SEQUENCERS
10	TH	AB-5 SCANNER TO REMOTE SLC 500 SERIES
10	LAB # 8	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONFIGURE , SET-UP, OPERATE ANALOG IN / OUT CARDS
11	TH	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR AB-5
11	LAB # 9	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONFIGURE , SET-UP, OPERATE ANALOG IN / OUT CARDS ALONG WITH PID AND PERFORM AN OPEN LOOP LAB ASSIGNMENT
12	TH	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR SLC-500 SERIES
12	LAB # 10	AB-5 REMOTE I/O AND ADAPTOR MODE
13	LAB # 11	TH -LAB AB-5 REMOTE I/O TO SLC 500 SERIES
13	LAB # 12	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR AB-5
14	LAB # 13	TH LAB PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR SLC-500 SERIES
14	LAB	REVIEW FOR TEST ON ALL MATERIAL INCLUDING LABS
15	TH	TEST ON ALL MATERIAL INCLUDING LABS
15	LAB	PRACTICAL TEST ON EITHER SLC OR AB - 5
16	TH	COMPLETE LABS AND WRITE-UPS
16	LAB	COMPLETE LABS AND WRITE-UPS

Fall 00		STUDENT GROUPS	
		1,,3, 5, 7, & 9	2,4,6,8,& 10
WKs			
1	**Lab THEORY**	AB-5 HARDWARE AND SOFTWARE SET UP OF ANALOG IN / OUT CARDS	
1	**LAB TH**	AB-5 HARDWARE AND SOFTWARE SET UP OF ANALOG IN / OUT CARDS	
2	**Lab THEORY**	BASIC SLC 500 HARDWARE , OPERATIONAL THEORY , ADDRESSING AND INTRODUCTION TO RS LOGIC 500	
2	**LAB TH**	BASIC SLC 500 HARDWARE , OPERATIONAL THEORY , ADDRESSING AND INTRODUCTION TO RS LOGIC 500	
3	**Lab THEORY**	AB-5 SOFTWARE SET UP OF ANALOG IN / OUT CARDS WITH PID AND MATH FUNCTION IN LADDER LOGIC PROGRAMMING	
3	**LAB**	LAB # 1A	LAB # 1B
4	**Lab THEORY**	SLC 500 ANALOG IN / OUT	
4	**LAB**	LAB # 2	LAB # 6
		NOTE READ SECOND YEAR NOTES ON AC & DC DRIVES	
5	**Lab THEORY**	SLC 500 ANALOG IN / OUT AND PID AND OTHER MATH FUNCTIONS	
5	**LAB**	LAB # 3	LAB # 7
6	**Lab THEORY**	REVIEW FOR TEST ON ALL MATERIAL INCLUDING LABS	
6	**LAB**	LAB # 4	LAB # 8
7	**Lab THEORY**	TEST ON ALL MATERIAL INCLUDING LABS	
7	**LAB**	LAB # 5	LAB # 9

8	Lab THEORY	AB-5 REMOTE I/O AND ADAPTOR MODE		
8	LAB	LAB # 6		LAB # 2
9	Lab THEORY	AB-5 REMOTE I/O SLC 500		
9	LAB	LAB # 7		LAB # 3
10	Lab THEORY	AB-5 SCANNER TO REMOTE SLC 500 SERIES		
10	LAB	LAB # 8		LAB # 4
11	Lab THEORY	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR AB-5		
11	LAB	LAB # 9		LAB # 5
12	Lab THEORY	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR SLC-500 SERIES		
12	LAB	LAB # 10		LAB # 11
13	LAB	LAB # 11		LAB # 10
13	LAB	LAB # 12		LAB # 13
14	LAB	LAB # 13		LAB # 12
14	LAB	REVIEW FOR TEST ON ALL MATERIAL INCLUDING LABS AND COMPLETING LABS		
15	Lab THEORY	TEST ON ALL MATERIAL INCLUDING LABS		
15	LAB	PRACTICAL TEST ON EITHER SLC OR AB - 5		
16	Lab THEORY	COMPLETE LABS AND WRITE-UPS		
16	LAB	COMPLETE LABS AND WRITE-UPS		

COURSE NAME	COURSE NUMBER
Automated Electrical Systems	ELR 320

COURSE NAME			COURSE NUMBER
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Student Lab Evaluation Sheet

Student's Name_____   Mark out of 120   _____

120

NOTE: Each student must turn in his/her own sheet with each lab demonstration verified by the instructor signature. If the student does not turn the sheet with all lab signed by the instructor

Lab #	Description	Demo Mark	Instructor's Signature	Write-up Mark
1	LAB SET-UP & MOUNT HARDWARE BOTH AB-5 LAB #1A & SLC 500 SERIES LAB # 1B	no mark xxxxxxx		No mark Xxxxxxx
2	SET-UP AB-5 ANALOG IN & OUT CARDS			
3	SET-UP ANALOG IN & OUT CARDS ALONG WITH THE PID BLOCK & PERFORM AN OPEN LAB ASSIGNMENT			
4	SMC / 1305 / 1336 optional	no mark		No mark
5	SMC / 1305 / 1336 optional	no mark		No mark
6	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONTROL 3 MOTORS			
7	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONTROL TRAFFIC LIGHT USING TIMERS LIMIT TEST & SEQUENCERS			
8	PROGRAM SLC 500s USING RS LOGIC 500 FROM B1050 TO CONFIGURE , SET-UP, OPERATE ANALOG IN / OUT CARDS			
9	PROGRAM SLC 500s USING RS LOGIC 500 WITH PID AND PERFORM AN OPEN LOOP LAB ASSINGMENT			
10	AB-5 REMOTE I/O AND ADAPTOR MODE			
11	AB-5 Remote I/O To SLC 500 Series PLC			
12	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR AB-5			
13	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR SLC 500 Series PLCs			
	Total Marks			

COURSE NAME	COURSE NUMBER
Automated Electrical Systems	ELR 320