

I. COURSE DESCRIPTION:

The student will develop an understanding of control system integration equipment such as different PLCs, MMIs, AC & DC drives and instrumentation. 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. 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.)**

- 1) Upon successful completion of the theory portion of the course the student will demonstrate the ability to:

Potential Elements of the Performance:

- Identify 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 Mode 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.

- 2) 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.

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Required resources will be supplied by the instructor.

V. EVALUATION PROCESS/GRADING SYSTEM:

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

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

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%	in theory, practical test Lab

Write-ups component and/or Lab Demonstration to Instructor (repeat course)

VI. SPECIAL NOTES:

- **In order to maintain a passing grade the student must obtain a minimum 60% average in both the theory Tests, Practical 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). 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.**

VII. PRIOR LEARNING ASSESSMENT

Students who wish to apply for advanced credit in the course should consult the instructor.

ELR 320-7 Fifth Semester

- 6 SLC 500 ,, 2-504,, 3-503,, 1-502
- 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 MMI software

	Fall 99	ELR 320 -7 Automated Systems 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 99		STUDENT GROUPS	
		1,,3, 5, 7, & 9	2,4,6,8,& 10
Wks			
1	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	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	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	THEORY	SLC 500 ANALOG IN / OUT	
4	LAB	LAB # 2	LAB # 6
		NOTE READ SECOND YEAR NOTES ON AC & DC DRIVES	
5	THEORY	SLC 500 ANALOG IN / OUT AND PID AND OTHER MATH FUNCTIONS	
5	LAB	LAB # 3	LAB # 7
6	THEORY	REVIEW FOR TEST ON ALL MATERIAL INCLUDING LABS	
6	LAB	LAB # 4	LAB # 8
7	THEORY	TEST ON ALL MATERIAL INCLUDING LABS	
7	LAB	LAB # 5	LAB # 9
8	THEORY	AB-5 REMOTE I/O AND ADAPTOR MODE	
8	LAB	LAB # 6	LAB # 2

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

ELR-320-7 Grading and Marks

Theory Test #1	10 marks	5 % overall
Theory Test #2	40 marks	12 % overall
Practical Test #1	50 marks	17 % overall

	Write-ups	Demonstration	
Lab #1	0 marks	0 marks	0% overall
Lab #2	5 marks	5 marks	3.3% overall
Lab #3	5 marks	5 marks	3.3% overall
Lab #4	5 marks	5 marks	3.3% overall
Lab #5	5 marks	5 marks	3.3% overall
Lab #6	10 marks	10 marks	6.6% overall
Lab #7	10 marks	10 marks	6.6% overall
Lab #8	10 marks	10 marks	6.6% overall
Lab #9	10 marks	10 marks	6.6% overall
Lab #10	10 marks	10 marks	6.6% overall
Lab #11	10 marks	10 marks	6.6% overall
Lab #12	10 marks	10 marks	6.6% overall
Lab #13	10 marks	10 marks	6.6% overall
Total	100 marks	100 marks	66% overall
Tests	50 marks		17% overall
Practical Test	50 marks		17% overall
Lab Write-ups	100 marks		33% overall
Lab Demonstration		100 marks	33% overall
Total	300 marks		100%

A+	90% to 100%
A	80% to 89 %
B	70 % to 79%
C	60% to 69%
R	59 % and under

Lab Write-ups Requirements

Labs 1A and 1B require no write-ups

- 1) Lab # 2 through and including Lab #13 all require write-ups and demonstration as outlined below.
- 2) 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.
- 3) Labs shall have a Hardwire Schematic Diagram completed in AutoCAD or an acceptable alternate software drawing program.
- 4) Labs shall have an AutoCAD or other acceptable alternate 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 were applicable
- 5) Labs shall have an I/O listing,
- 6) 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.
- 7) 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
- 8) Labs that require tables shall be done in a spread sheet or a word processor the can produce a table.
- 9) 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 of the particular lab is scheduled
- 10) If the student is not clear on any of the lab requirements, it is his/her's responsibility to ask the instructor for clarification

NOTE:

- Each student must demonstrate the lab to the instructor and turn in a write-up as outline. The student must obtain a
- passing mark (grade) in each area of the course as described below.
- Tests, including Practical test student must obtain 60%
- Write-up, student must obtain 60% and turn in a write-up for all 12 lab (2 to 13) to obtain a grade in this portion of the course.
- Demonstration, student must obtain 60% marks and the student must have demonstrated all 12 labs (2 to 13), to obtain a grade in this portion of the course.

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			
5	SMC / 1305 / 1336			
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			

COURSE NAME
Automated Electrical Systems

COURSE NUMBER
ELR 320

13	PEER TO PEER COMMUNICATION USING MESSAGE BLOCKS FOR SLC 500 Series PLCs			
	Total Marks			