SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE:	AUTOMATIC CONTROL SYSTEMS		
CODE NO. :	ELR3150	**SEMESTER:**	6
PROGRAM:	ELECTRICAL TECHNOLOGY		
AUTHOR:	R. CHARTRAND/ R. McTAGGART		
DATE:	JAN. 2003	**PREVIOUS OUTLINE DATED:**	JAN. 2002
APPROVED:			

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DEAN **DATE**

TOTAL CREDITS:	6
PREREQUISITE(S):	ELR2230, ELR3200
HOURS/WEEK:	4

I. COURSE DESCRIPTION:

The student will develop an understanding of control system integration of PLCs, MMIs, AC & DC drives and instrumentation Advanced PLC techniques and MMI software will be used to design, document and commission automated control systems. The student will interface PLC control with MMIs to control industrial drives and process control loops.

Classical control theory will be introduced to assist with project implementation.

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) Assist in the design of a variety of control systems.

Potential Elements of the Performance:

- utilize block diagrams and transfer functions to model basic control systems

- derive the Laplace transform of a time domain function

- use tables to find inverse Laplace transforms

- simplify block diagrams

- discuss criteria for system stability using Bode diagrams and s-plane analysis

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

2) Develop and demonstrate animated graphic for MMI displays and advance programming of MMI screens

Potential Elements of the Performance:

- the ability to program animated graphic screens for MMI
- the ability to program MMI to display various variables in both digital and animated forms
- the ability to set-up animated control functions on MMI graphic screens

3) Develop advance PLC programs to control various electrical equipment
   Potential Elements of the Performance:

   - the ability to program PLCs and MMI to control Motor Drives, AC Variable Frequency Drives and Soft-starts
   - the ability to program PLCs and MMI to retrieve and display motor control functions and operational data
   - the ability to connect PLCs in Scanner mode (master) or adapter mode (slave) to transfer or retrieve information from smart equipment through either Peer to Peer or Remote I/O communications

4) Assemble and connect a variety of automated equipment to perform process control and to develop Process Control PLC programs and MMI control and data acquisition
   Potential Elements of the Performance:

   - the ability to program PLCs to control two and three loop processes (cascading)
   - the ability to program MMI (RS View) to Control Two and Three Loop Process with PLCs

5) Assemble and connect a variety of electrical automated equipment to perform as integrated systems utilizing task and control through MMI software and PLC Hardware and Smart equipment
   Potential Elements of the Performance:

   - the ability to program PLCs, MMI, to perform selected tasks over different networks from local and remote locations
   - the ability to program, connect PLCs, MMI, and control process control loops and smart equipment through Ethernet and DH+ Protocols from remote locations
   - the ability to connect and implement basic safety circuits and requirements for control systems.
   - Select and connect several different types of electrical equipment such as Motor Drives, PLCs, Process Control Equipment, MMIs along with sensing device and output power devices into a structured unified controlled system performing simulated tasks

III. TOPICS:

1) Overview of control terminology and principles.

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

3) Overview of MMI software.

4) Overview of PLC/PC networking.

5) Advanced PLC programming.

6) Motor drive control with PLCs. And MMI software

7) Introduction to multiple process control and system integration control, interconnection and operation.

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Textbook not required

V.EVALUATION PROCESS/GRADING SYSTEM

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

THEORY 40%

PROJECTS / LABs Demonstrations, Write-ups and practical tests 60%

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 < 60% in theory and/or project component (repeat course)

VI. SPECIAL NOTES:

- In order to maintain a passing grade the student must obtain a minimum 60% average in both the theory and project 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.

VII. PRIOR LEARNING ASSESSMENT

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

ELR 315-6 Sixth 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
4 G2 Interfacing Cards
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

ELR-315-6 Grading and Marks

	Write-ups		Demonstration
Lab #1	5 marks		5 marks
Lab #2	5 marks		5 marks
Lab #3	5 marks		5 marks
Lab #4	5 marks		5 marks
Lab #5	10 marks		10 marks
Lab #6	10 marks		10 marks
Lab #7	10 marks		10 marks
Lab #8	10 marks		20 marks
Lab #9	20 marks		20 marks
Lab #10	20 marks		20 marks
Total	100 marks	=	100 marks

Demonstration total mark 100% will be = to 10 % overall

Write-ups total mark 100% will be = to 20 % overall

Practical Test #1 100 % will be = to 10 % overall

Practical Test # 2 100 % will be = to 20 % overall

Theory mark 100% will be = to 40 % overall

Final mark = 100% overall

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

Lab Write-ups Requirements

ALL Labs require write-ups and demonstration as outlined below.

1) 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.
2) Labs shall have a Hardwire Schematic Diagram completed in AutoCAD or an acceptable alternate software drawing program.
3) 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
4) Labs shall have an I/O listing,
5) Labs shall have a detailed 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.
6) The information in the lab write up must be sufficient in detail and clarity as to allow a person with limited PLC knowledge to be able to reproduce the lab's functions. That is this person should be able to program the plc with the enclosed program, wire the hardware, configure hardware, configure software and run the program successfully, reproducing the same operation functionality.
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, word-processor write-ups and PLC programs
8) Labs that require tables shall be done in a spread sheet or a word processor that 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

I. Demonstration, student must correctly demonstrate the labs and the student must have demonstrated all labs, to obtain a grade in this portion of the course.

II. Demonstrations will be graded either correct, complete, or not correct, incomplete.

III. If the lab demonstration is correct and complete the instructor will sign the lab sheet only at the time of the demonstration. So students must have their lab sign sheet at every demonstration.

IV. In the case of a demonstration that the instructor assess an incomplete or it is not correct in any aspect in the instructors opinion, it is considered not finished and the instructor will not sign the lad sheet. Students must redemonstrate the incomplete labs to the instructor and must obtain a complete assessment before the instructor will sign lab sheet for these labs

V. Students will be assess 10 % reduction in the particular lab mark for every re demonstration of an incomplete lab.

NOTE:

1) 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..

2) Write-up, student must obtain **60%** and turn in a write-up for all labs assignments to obtain a grade in this portion of the course.

3) Tests, including any Practical test student must obtain 60%

Student Lab Evaluation Sheet

Student's name _____

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 the lab will be considered not complete and the lab write ups will not be marked until all labs are demonstrated and complete

Lab #	Description ALL labs Must have MMI control and screens associated with it and all programs must be written will a min. of 1 subprogram file completely documented	Demo Mark	Instructor's Signature	Write-up Mark
1	PLC-5 Scanner to SLC 504 Adapter Communications using DMC card in SLC 504 with simple Start / Stop MMI Control and one light. Run/Stop light in PLC adapter, and scanner .	5		5
2	PLC-5 Scanner to PLC5Adapter Communications using Block Transfers with simple Start / Stop MMI Control and traffic light. Run traffic light in PLC adapter, scanner controlling timing sequence	5		5
3	PLC- 5 to SLC-504 as PEER To PEER Communications with Start / Stop MMI control along with animated MMI Functions to simulate the operational functions of a control circuit the PLCs are responsible for controlling eg multiple motor sequential control etc. Min. 3 motor control forward and reverse with jog FWD, jog REV for each motor. Build HMI screen for these motor and controls	5		5
4	PLC- 5 to SLC-504 : SLC 504 as remote I/O to PLC 5 again use MMI control integration and data display. Connect analog input signal to the slick and transfer it to the PLC 5 which is to output the same analog value percentage out an analog output channel. Again simulate a process with the HMI and display it	5		5
5	PLC-5 Communications and control of a AB 1336 VFD through discrete and analog control use MMI control animated and operational data display	10		10
6	PLC-5 Communications and control of a AB 1336 through direct communication as 1336 connected as a smart I/O using the G2 interfacing adapter cards use MMI control animated and operational data display	10		10
7	SLC 504 Communications and control of a AB 1336 VFD through discrete and analog control	10		10
8	SLC 504 Communications and control of a AB 1336 through direct communication as 1336 connected as a smart I/O use MMI control animated and operational data display	10		10
9	PLC-5 Scanner to TWO PLC5Adapter Communications using Block Transfers with Start / Stop MMI Control and each PLC will control one Process loop in B1093, Pressure, Level, Flow loops. The scanner will ratio the set points to the adapter PLCs, one up 10% the other down 10% from setpoint value entered to the scanner PLC	20		20
10	Instructor will assign a project that that the student must, demonstrate to the instructor and write-up in step by step detail. You will also present this project explain and demonstrate it to the other members of the class	20		20
	Total Marks	100		100

NOTE: **ALL DEMONSTRATIONS** to the Instructor and **ALL WRITE-UPS** MUST BE handed in to the Instructor no Later then

The Second Last Lab Class for the Semester

5% will be deducted for each day the write-ups and demonstrations go beyond the dead line from the students mark.

The Practical Test 1 will be scheduled for the first lab class in March

The Practical Test 2 will be scheduled for the last lab class in the semester in April

Project Demonstrations to other members of the class will be schedule by the instructor.

NOTE: 5% will be deducted from the student's final mark for each non-attendance during his / her fellow class mates project demonstration. That is EACH PROJECT DEMONSTRATION MISSED BY A STUDENT WILL RESULT IN A DEDUCTION OF **5%** FROM HIS / HER'S FINAL GRADE

ATTENDANCE AT ALL DEMONSTATIONS ARE COMPULSERY

ATTENDANCE AT ALL DEMONSTATIONS TO THE INSTRUCTOR BY ALL STUDENTS OF THE DEMONSTRATING GROUP IS COMPULSERY .

If a student misses a demonstration to the instructor by his / her group, he / she must demonstrate the lab assignment to the instructor before the student will receive a grade for that particular lab assignment. This will result if not demonstrated at all by the student to the instructor by the April deadline in an R grade being issued for the lab section of the course.

REMEMBER THE DEADLINE IS Second Last Lab Class (This is in April)