

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO



**SAULT
COLLEGE**

COURSE OUTLINE

COURSE TITLE: AUTOMATIC CONTROL SYSTEMS
CODE NO.: ELR315 **SEMESTER:** SIX
PROGRAM: ELECTRICAL TECHNOLOGY
AUTHOR: R. CHARTRAND
DATE: JAN 2014 **PREVIOUS OUTLINE DATED:** JAN 2013
APPROVED: *“Corey Meunier”*
CHAIR DATE
TOTAL CREDITS: SIX
PREREQUISITE (S):
HOURS/WEEK: SIX

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For additional information, please contact Corey Meunier, Chair
School of Technology & Skilled Trades
(705) 759-2554, Ext. 2610

I. COURSE DESCRIPTION:

The student will develop an understanding of control system integration of equipment such as different PLCs, HMIs, analog / discrete cards, communication interfaces for instrumentation Process Control, Drive Control and Industrial Networks. Advanced PLC techniques using Allen Bradley family PLCs will be used to connect commission and document individual sections and components of an automated control system. The student will program PLCs using advanced instruction, program files and utilize the trending and troubleshooting features of the software programs. The student will interface PLCs to control a level loop with a Master / Scanner PLC and communicate calculated set points to Adaptor / Slave PLCs controlling flow loops and pressure loops. The student will interface PLCs to control drives & robotic equipment through analog and direct communication and using encoders or tach. feedback. The student will develop advance HMI programs to run each project including trending and troubleshooting screens. The student will be introduced to DeviceNet, ControlNet, & Ethernet IP networks and components. The student will also be introduced to functional block and SFC programming techniques. This course will require the student to work independently and / or in groups during lab times. The student will also be required to work independently on assigned work outside of class time and access information from help files, manuals, and internet as necessary to solve PLC related work problems. This is to prepare the student for PLC job related tasks.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. ***Understand various Basic Terminology, Concepts of a PLC Control System networks and functions of AB PLC with in these networks and Assist in the design of a variety of control systems.***

Potential Elements of the Performance:

Utilize block diagrams to model basic Networked control systems

- Identify different industrial network systems such as DeviceNet, ControlNet, DH+, and Industrial Ethernet etc.
- Basic Setup and installation of industrial networks
- Purpose and use of the above industrial networks
- Restrictions and imitations of the above industrial networks

2. ***Develop and demonstrate animated graphic for HMI displays and advance programming of HMI screens.***

Potential Elements of the Performance:

- The ability to program animated graphic screens for HMI

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

3. *Develop advance PLC programs to control various electrical equipment.*

Potential Elements of the Performance:

- The ability to program PLCs and HMI to control Motor Drives, AC Variable Frequency Drives and Soft-starts
- The ability to program PLCs and HMI 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 HMI 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 HMI (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 HMI software and PLC Hardware and Smart equipment.*

Potential Elements of the Performance:

- The ability to program PLCs, HMI, to perform selected tasks over different networks from local and remote locations
- The ability to program, connect PLCs, HMI, 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, HMIs along with sensing device and output power devices into a structured unified controlled system performing simulated tasks.

III. TOPICS:

1. OVERVIEW OF INDUSTRIAL NETWORK CONTROL TERMINOLOGY AND PRINCIPLES.
2. OVERVIEW OF INDUSTRIAL CONTROLS AND AUTOMATION HARDWARE/SOFTWARE.
3. OVERVIEW OF DATA COLLECTION & GRAPHING SOFTWARE.
4. OVERVIEW OF PLC/PC NETWORKING.
5. ADVANCED PLC PROGRAMMING FUNCTION BLOCK, & OTHER LANGUAGES
6. MOTOR DRIVE CONTROL WITH PLCs. AND HMI SOFTWARE
7. INTRODUCTION TO MULTIPLE PROCESS CONTROL AND SYSTEM INTEGRATION CONTROL, INTERCONNECTION AND OPERATION.
8. OVERVIEW OF EXCEL AND RSLOGIC SOFTWARE.

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Instructor will indicate this in the first theory class

V. EVALUATION PROCESS/GRADING SYSTEM:

Theory Test	25 marks	25% overall
Lab demonstrations	35 marks	35% overall
Lab Write-ups	40 marks	40% overall
Total 100 marks		100%

The following semester grades will be assigned to students in postsecondary courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 - 100%	4.00
A	80 - 89%	4.00
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 - 59%	1.00
F (Fail)	49% and below	0.00
CR (Credit)	Credit for diploma requirements has been	
S	Satisfactory achievement in field /clinical placement or non-graded subject area.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

VI. SPECIAL NOTES:**Attendance:**

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session **It is the departmental policy that once the classroom door has been closed, the learning process has begun. Late arrivers will not be granted admission to the room.**

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General Information to include in course outlines**Special Accommodations:**

If you have a special learning need or issue, it works to your advantage to notify your instructor immediately if special devices or assistance will help you in this class.

Classroom Etiquette:

Pagers and cell phones should be either turned off or set to vibrate mode during class. Please show courtesy to the class by restricting conversation to in-class topics, and raise your hand to gain attention when asking a question or raising a point of discussion.

Class Room Safety:

Safety is the most important aspect in this course and any compromise in student safety by any other student will not be tolerated. Students that observe any unsafe lab condition and/or act must report it to the instructor immediately. Student safety in the Labs is the number one priority. Students are to contact the instructor before working on any live equipment that they are not familiar with or have not been instructed in the safety procedures of that particular equipment.

Turning in Work:

Be sure to include your name and the course name and section on all work to be turned in.

Late Coursework:

All assignments are to be turned in on the due date. Students may be allowed to make up any late work at the instructor's discretion.

Term tests/quizzes

With the expectation that the student will attend all classes, there will be no make up tests for missed tests. There will be no rewrites for low-test scores.

Attendance

Students' attendance and participation are required in all activities. If a student is absent from class, it is her/his responsibility to find out what was missed prior to the next class and complete any assigned work **before** the next class. Absence does not constitute a reason for missed work or late assignments.

ADDITIONAL:

Since all work must be performed on special network computer software located at the college, there will be little opportunity to work on the projects at home. The reading, review questions, and planning must be done outside of class time.

All student assignment materials that are not picked up by the student will be held for a maximum of two weeks after grading. After this time materials may be discarded or used at the professor's discretion.

Attendance may be monitored. Regular absentia may be reported to OSAP at the college's discretion.

- VII.** In order to maintain a passing grade the student must obtain a minimum **50%** average in all subject sections that the course may have, such as, the theory Tests section, Practical Tests section, Projects & Project Write-ups and Demonstrations of Projects to Instructor section.

If a student misses a test he/she must have a valid reason (e.g. 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.

The Instructor, if time permits, will summarize the main points of this course outline in the first Lecture. Student's questions related to the course outline will be addressed at that time. The Instructor through out the course may also expand on particular items related to the course outline and the course requirements.

It is the responsibility of the student to read the course outlines and be aware of the course requirements.

Students are expected to maintain an active Sault College email account.

They are required to check this email account daily. The instructor may announce details of lab and test requirements and scheduling through the Sault College email system (as well as sharing other important information).

VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.

ELR 315

TABLE OF CONTENTS EQUIPMENT

SLC 500, 2-504, 3-503, 1-502

analog in and out

panel mates

input and output sets

scanner card

DMC card

Link couplers RS 485

1305, 1336 & 1336 plus AC Drives

G2 Interfacing Cards or other Interface cards

Powerflex 70 & 700 AC Drives

SMC with built in discrete interface discrete & remote I/O

AB 5 Family Processors and Rack with 24 VDC Discrete I/O

Analog In and also Out Cards for the AB 5 Processors

PLC 5000 and associated hardware and software

Note: May includes any other Hardware and or Software that instructor will discuss or assign that is not mentioned above.

General Lab Requirement for Write Ups

ALL Projects require write ups as outline below

- 1) All Projects assignments must be turned in on hard copy and on computer disk before or no later than the last lab class of the semester. The disk will contain all programs, drawing in AutoCAD and word processor work.
- 2) Each Project may have specific requirement so read each Project carefully.
- 3) If the student is not clear on any of the requirements, it is his/her responsibility to ask the instructor for clarification
- 4) Project reports are to include all procedures, diagrams and observation etc required in this course outline for the project write-up to be complete. The projects are to be placed in binder or other suitable binding (project book), and in the exact order and numbered to match the project demonstration sheet
- 5) One submission per group of a Project Book containing all project reports. Maximum 2 student per group per group
- 6) Project reports submitted with grammatical and/or spelling errors will receive a grade of 0. Word processors have spell check, it is expected students will use it
- 7) Students must sign and provide the instructor with a copy of this page before being permitted to work in the lab. No project will be marked until this document is read by the student and signed by the student. If there are any questions related to this document, please ask the instructor prior to signing and turning in this sheet. When the instructor receives this signed sheet, the instructor will accept this as conformation that the student understands all of the requirements of this course as stated in this document and course outline.

Note: Specific Lab Requirement for Write Ups will be given by the instructor in the beginning of the semester

Methods of Evaluation

Demonstration of Labs, Lab write-ups and tests etc. will constitute a total of 100% of your ELR 315 course mark. The distribution of marks is as stated in the previous pages.

NOTES:

- Attendance is compulsory and may be taken each and every lab class
- Two percent per lab class will be deducted for each scheduled lab class missed without permission by a student from his final grade up to a maximum of 30%.
- Every student will be allowed to miss only one lab class without a doctor's slip without any marks being deducted for that missed lab class.
- Students missing more than 1 lab class must have a doctor's slip or the 2% per missed lab class will be deducted from his/her's final lab mark.
- Example the second miss lab class will result in the student having 2% deducted from his/her's final lab grade, e.g. Final mark of 100 % - 2% = 98% or 65% - 2%= 63%
- Students missing any lab classes will still be responsible to have the particular lab completed, not simply copied from other student. You must indicate to the instructor when you plan to do the lab, you will be responsible for making arrangements to complete the lab and demonstrate it to the instructor.
- All drawings or diagrams must be done in AutoCAD or instructor approved drawing program.
- All project write-ups will contain the material that was stated here and in supplemental hand out given to the student by the instructor.
- All project books must be turned in, in a binder, in the stipulated order and content, the second last week of the course up to Friday noon for marking. The project book turned in after this time will be deducted 2% per day late. No project books will be accepted for marking after the last lab class of the semester. No project books turned in will result in the student obtaining an F (fail) grade
- All projects must be signed by the instructor at the completion of each and every lab shop portion during the scheduled lab class. Therefore when you have completed the project and demonstrated the lab projects to the instructor, will sign the lab project and you may proceed with the next lab project assignment. Auto Cad drawings, and all other lab project requirements must be met before the labs can be handed in for marking.
- The student must demonstrate all lab projects assigned to the instructor's satisfaction before the student can have the lab project signed by the instructor as being complete.
- The instructor may alter or give particular instructions, or additional instructions on a per lab project bases.
- When projects are demonstrated they must be working correctly and safely to the satisfaction of the instructor in the required time frame. If the project when demonstrated does not work as required or is not completed in the stated time frame this will result in a mark of (0) zero for that project. The student will not be able to redo the project if the stated time frame will be exceeded. The student must move on to the next project. If the student does not demonstrate all projects assigned he/she will receive an F (Fail) grade for ELR 315.

REMEMBER:

Read all Projects completely and any additional material that is included or handed out by the instructor that pertains to the labs. The student is responsible to make sure that he / she have read all martial pertaining to a lab before starting the lab.

This course will require the student to **work independently** and / or in groups during lab times. The student will also be required to work independently on assigned work outside of class time and access information from help files, manuals, and internet as necessary to solve PLC related work problems. This is to prepare the student for PLC job related tasks.

ALL students must **demonstrate all labs** to the instructor and have the instructor sign your sheet that each lab was completed successfully. The sheet will be given to you by the instructor during the first lab period.

Note: the sheet discussed above must be turned in with the lab write ups during the last lab class of the semester with all labs signed on the sheet and demonstrated to the instructor. If the sheet is not with the lab write-ups, the write-ups will not be accepted for marking until the student re-demonstrates selected labs which the instructor will select as proof that the student has successfully completed the practical parts of the labs. The student will have to make arrangements with the instructor for a time to demonstrate his/her practical skill. If the student is successful in the practical demonstration his/her labs will be evacuated as if the student had turned in their signed sheet.

YOU ARE RESPONSIBLE FOR YOUR SHEET NO EXCUSES WILL BE ACCEPTED

You must pass all sections of the course, theory, the demonstration part of the course and the write up portion of the course to obtain a passing grade in this course. If the student passes all sections the final mark will be the mark as state for each section added together for the final mark. That is the theory mark, and demonstration marks will be added with the write up marks to arrive at a final student average for this course. If the student fails any one section of this course he/she will receive an F grade (failing grade).

Student Lab Evaluation Sheet Will be distributed by the Instructor at the beginning of the Course

NOTE: Each student must turn in his/her own sheet with each Project demonstration verified by the instructor signature. If the student does not turn the sheet with all Projects signed by the instructor the write-up will not be marked.

STUDENT COURSE AGREEMENT (Please print)

I, _____ with regards to the course known as ELR 315
Automation Control Systems COURSE CODE # ELR 315 have read and
understood the course outline along with course content, and expectations
which clearly states the following:

- 1- Absolutely no make up tests or exams or extensions will be administered with the exceptions of personal illness or death of an immediate family member both requiring written verification.
- 2- The student must be able to work in groups and or independently and resource all necessary information required to complete the projects. Resources can be internet, manuals etc.
- 3- All Projects must be handed in by the due date or a grade of 0 will be awarded.
- 4- Lab & lecture attendance are compulsory. Any lecture notes, Project assignments etc. missed will become the student's responsibility to retrieve from another student.
- 5- All Projects must be completed during assigned Lab times unless prior approval is obtained from the instructor.
- 6- Students must be able to demonstrate Projects that are assigned by the instructor on or before the due date. Each student must be sure that he / she can duplicate the Project that they turned in on or before the due date. If the student cannot duplicate the Project to the satisfaction of the instructor, a grade of 0% will be assessed to that particular Project. Demonstration request will be at the discretion of the instructor.
- 7- In order to maintain a passing grade the student must obtain a minimum 50% average in all subject sections that the course may have, such as, the theory Tests section, Practical Tests section, Projects & Project Write-ups and Demonstrations of Projects to Instructor section
- 8- Students are not permitted to work on live equipment outside of regular class time.
- 9- Students must supply their own hand tools, meters and safety glasses. Students will not be permitted in the lab without safety glasses and the student must wear the safety glasses whenever working on live equipment. Students must never work alone in the lab. Unsafe work habits, improper behavior will not be tolerated.

I have read and understand the requirements outlined in this document and in the course outline.

Name (print): _____

Signature: _____

Date: _____

Lab #	Description ALL labs Must have HMI control and screens associated with it	Overall Demo Mark	Instructor's Signature	Write-up Mark %
1	Program Plc. 5 Using RSLogix Configure, Set-Up, Operate Analog In / Out Cards Program Plc. 5 ,Then Using RSLogix With PID And Perform An Open Loop Lab Test Then Control Instrumentation Trainers Level Loop with HMI Program to be Written in Ladder	5		5%
2	Program Plc. 5000 Using RSLogix PID in the 5000 FB message to Flexlogix processor to receive PV and to output CV to Flex Configure, Set Up, Operate Analog In / Out Cards Program Flexlogx, for one trainer, Do all scaling in Flexlogix Then Using RSLogix With PID And Perform An Open Loop Lab Test Then Control Instrumentation Trainers Level Loop with HMI Program to be Written in Function Block Language in the PLC 5000 and Ladder/FB in the Flexlogix Processor. PB switches connected to Flexlogix & 5000 to start/stop process. Communication either Controlnet or Ethernet depends on Flex.	15		15%
3	PLC-5000 Communications and control of a AB PowerFlex drives through direct communication as a smart I/O with HMI animated control and operational data display using FB programming	10		10%
4	Producer Consumer Communication Between Two Plc. 5000 FB Over Controlnet With HMI to control 2 Powerflex drives. Drive on Controlnet. Let speed / direction of one drive alter speed/direction of second drive	15		15%
5	PLC 5000 FB Communications and control of a AB 1336 VFD through discrete and analog control use HMI control animated and operational data display or SLC 504 can be used in place of the PLC 5	15		15%
6	Plc-5000 FB communications and control of a AB. 1336 or other ac drives through direct communication DH+/RIO card as a smart i/o using the RIO adapter card & use HMI control animated and operational data display	10		10%
7	PLC 5 in master / slave config. Connect the 2 instrumentation loops (level, pressure, & or flow) to simulate a process. Instructor will discuss this project in the class. Use HMI control animated and operational data display along with RSTUNE.	10		10%
8	PLC 5000 Write a program in Sequential Function Chart Programming Language that will run the Hercules Robot	10		10%
9	PLC 5000 Write a program in Structured Text Programming Language that will run the Hercules Robot	10		10
	Total Marks	100		100